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Assessment of American plaice, *Hippoglossoides platessoides*, in NAFO Division 4T

by

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ABSTRACT

The provisional catch of American plaice in NAFO Division 4T in 1989 was 4,987 t. The proportion of the total catch taken by seines was 46%, representing an increase of 8% from 1988. Bottom trawls took 39% of the total catch. Standardized catch rates from multiplicative analyses in the American plaice directed, cod directed and combined fisheries showed stability in the American plaice directed component and a decline in catch rates from the 1970s in the other two indices. None of the indices were considered to accurately reflect stock size because of violations in the assumptions of the multiplicative model. Research vessel (RV) mean numbers per tow in 1989 were the lowest in the series. The average total mortality estimates for fish of age 8-18 from the RV data were 0.36 for 1971-79 and 0.53 for 1980-89. Assuming natural mortality to be 0.2, fishing mortality during the 1980s was therefore above $F_{0.1}$. Projections assuming constant recruitment, natural mortality, and growth gave yields between 4,699 and 7454 t. Fifteen per cent of the mature biomass, as determined from RV survey gave a yield of 3,220 t. Therefore, a TAC of between 3,000 t and 8,000 t is considered to be closer to the $F_{0.1}$ level for this stock than the current TAC of 10,000 t. However, a restrictive quota may result in increased discarding at sea.

RÉSUMÉ

Les prises de plie canadienne dans la division 4T de l'OPANO en 1989 se sont établies à 4 987 t (chiffre provisoire), dont 46 p. 100 ont été capturées à la senne - huit pour cent de plus qu'en 1988 - et 39 p. 100 au chalut de fond. Les taux de prises normalisés d'après les analyses multiplicatives effectuées dans les pêches directes de la plie canadienne et de la morue ainsi que dans la pêche mixte dénotaient une stabilité dans la pêche directe de la plie canadienne et une baisse par rapport à 1970 dans les deux autres formes de pêche considérées. Aucune des données de référence n'était perçue comme un reflet exact de la grosseur du stock, en raison d'écarts par rapport aux hypothèses du modèle multiplicatif. Les résultats moyens par trait obtenus par les navires scientifiques en 1989 étaient les plus bas de la série. D'après ces résultats, la mortalité moyenne totale pour les poissons de 8 à 18 ans se chiffrait à 0,36 pour 1971-1979 et à 0,53 pour 1980-1989. Si l'on se fonde sur une hypothèse de mortalité normale égale à 0,2, il s'avère que la mortalité due à la pêche durant les années 1980 a été supérieure à $F_{0.1}$. Les rendements obtenus dans des projections fondées sur une croissance, une mortalité naturelle et un recrutement constants, s'échelonnaient de 4 699 t à 7 454 t. Quinze pour cent de la biomasse à maturité donne un rendement de 3 220 t, d'après les données des navires scientifiques. Par conséquent, on estime qu'un TPA situé entre 3 000 t et 8 000 t serait plus proche du niveau $F_{0.1}$ que le TPA actuel de 10 000 t. Toutefois, un contingent plus restrictif pourrait aboutir à une hausse des rejets en mer.

INTRODUCTION

Since 1965 reported landings from the NAFO Division 4T American plaice stock have varied from a high of 11,780 t in 1966 to a current low of 4,987 t in 1989 (Table 1). A precautionary TAC of 10000 t has been imposed on the landings of this fishery since 1977. Average annual landings have been almost 1,500 t less than this. Landings for the last four years have been below 8,000 t.

Historically, the American plaice fishery was primarily a by-catch fishery of the southern Gulf of St. Lawrence cod fishery. Since 1986 a fishery directed for American plaice has taken roughly half the total landings. The stock is exploited both by mobile gears, such as otter trawler, Danish and Scottish seines, and fixed gears including gillnets, longlines and handlines. The composition of gears has changed from mainly longlines from 1937 to 1946 to a mixed fishery of longlines, otter trawl and Danish seine from 1947 to 1963 (Powles 1969). Since 1965 gillnets have been used also (Table 1). Danish seines have taken an increasing proportion of the total landings from 1965 to 1989 and are now the dominant gear type.

Reported Landings and Description of the Fishery in 1988

Reported landings for 1989 are tabulated from the provisional data supplied by the Statistics Branches of the Scotia-Fundy, Newfoundland, Quebec and Gulf regions of the Department of Fisheries and Oceans. The provisional estimate of landings for 1989 was 4,987 t, down over 1700 t's from 1988 and only 49.9% of the TAC. Reported landings by gear and month are presented in Table 2. Reported landings of flatfish in the entire Gulf of St. Lawrence are shown in Table 3. The total flatfish landings in the Gulf for 1989 are approximately 2800 t lower than the 27 year average.

The proportion of NAFO Division 4T American plaice landed in Quebec decreased from 38% of the total landings in 1988 to 34% in 1989 (Table 4). The Maritimes took virtually all the remaining catch (65.6%). The proportion taken by Danish, Scottish and pair seines increased from 38% of the landings in 1988 to 46% in 1989 (Table 1). Landings by fixed gear decreased substantially from 1,370 t in 1988 to 759 t in 1989 (Figure 1)

There have been no closures of the American plaice fishery in 4T since 1985 (Table 5). The mobile gear (M.G.) (vessel length classes 65-100', 45-65' and <45') fishermen caught substantially less than their allocations. The fixed gear (F.G.) fishermen also caught less than their allocation of 1500 t. Closures in the cod fishery to protect young cod (G. Chouinard

Canadian Dept. of Fisheries and Oceans, Moncton, N.B., pers. comm.) may have impacted the fishing patterns of American plaice fishermen. The impact may have occurred in two ways: 1) when the cod fishery was closed more vessels would be directed towards American plaice; 2) fishermen complained that they were forced to stop fishing groundfish altogether during the cod fishery closures because they quickly exceeded their by-catch of cod when fishing for American plaice. This latter effect was most severe for the P.E.I. fishermen.

Age Determination

The procedures for calibration and age error checking used by the Gulf, MAFD cod program were applied throughout age reading (Tallman MS 1988 and Chouinard et al. 1987). The results of age reader agreement tests reading are shown in Table 6. The overall agreement was 70 to 80 % with no bias.

INPUT DATA

A) Commercial Fishery Data

i) Landings and Weight at Age

Sampling of the commercial fishery in 1989 was comparable to previous years. Samples were taken from April to November when over 99% of the landings were taken. Over 15,800 fish were measured in 1989 (Table 7), and of these ages were determined for 2,246 fish.

Semi-annual age-length keys, were prepared for the periods before and after July 31. This split provided the best balance for the temporal aspects of the fishery which began in April and closed by the end of November (Table 2). As well, the partition provided the best balance of landings, ages and lengths sampled within the major gear types (Tables 2, 4, 5). We assumed that age at length was unaffected by gear sampled and combined otoliths within each half of the year to make the semi-annual keys.

The length frequencies by gear and semi-annual period weighted by the corresponding landings were used with the appropriate age-length key to obtain the landings at age by gear and half year period (Table 8). Sampled gears were grouped in the following categories: 1) otter trawls and paired bottom trawls (PTB's); 2) seines, Danish and Scottish; 3) gillnets and longlines. Unsampled landings were incorporated by multiplying the landings at age for sampled gears by the ratio the total landings over sampled landings.

All calculations of age-length keys and landings by gear

within semi-annual periods were done for each sex separately. The landings at age for males, females and juveniles were combined to give the overall landings at age for a gear type.

Landings at age and their variances by gear and semi-annual period are presented in Tables 9 and 10. Variances are similar to those recorded in recent years.

Weights at age from 1976 to 1989 were determined using a length-weight relationship calculated from RV survey data for each year . The parameter estimates for the power curve ($Y=aX^b$) for 1976 to 1989 are shown in Table 8. The correlation coefficients for the regressions in 1989 were 0.97, 0.96 for the males and females respectively. The lengths and weights at age for 1989 by sex are shown in Tables 11 and 12.

A decline in the average length at age from the first to second half of 1989 was observed in some age groups of the female American plaice caught by otter trawl. Tallman (1990) suggested that this effect was a result of the movement of the trawler fleet from the south-eastern part of the the southern Gulf of St. Lawrence to the north-western Gulf during the course of the fishing season. American plaice in north-western 4T grow more slowly than those of south-eastern 4T. Hence, the fleet may land smaller fish at age during the latter half of the year. An alternative hypothesis (Tallman 1990) is that the larger fish may migrate into a winter refugium in the Laurentian Channel somewhat sooner than the smaller fish. Clay (1990) and Powles (1969) showed that the Channel is utilized by American plaice during the colder months. In 1989, there appearred to be no striking decline in size at age from the first half of the year to the last (Table 12).

The combined landings at age for 1976 to 1989 are shown in Table 13. In 1989 fewer fish over age 13 were caught relative to 1988. The matrix shows some strong year classes apparently recruiting to the fishery in the late 1970's. In the 1980's recruitment appears to be much less. Coefficients of variation of the landings at age from 1976 to 1989 shown in Table 14 are low and thus the landings at age are well estimated.

B) Catch at Age

The stratified-random bottom trawl survey carried out by research vessels in NAFO Div. 4T during September of each year since 1971 (Halliday and Koeller 1981) supplied the raw data for the calculations. The survey trawl was equipped with small mesh liners of 32mm in the lengthening piece and 6mm in the codend (Halliday and Koeller 1971). According to Clay (1979) this should retain 50 per cent of the American plaice of 7 cm in length. However, Halliday et al. (1989) noted that survey catches had a modal length of 22 cm suggesting that fish smaller

than this may not have been fully recruited to the gear. Even so, over the size range expected in commercial catches (greater than 20 cm) the survey probably gives an unbiased estimate of the population size structure available to commercial gear.

Length frequency distribution for each sex was calculated from the RV database to provide an estimate of the mean number per tow in each stratum of American plaice of each sex and length category within sex that was available to the fishing fleet in any given year. Between 1984 and 1986 length frequencies for sexes combined were taken. To convert these to sexed length frequencies the proportions of males, females and juveniles were estimated at each length from the RV detailed biological samples. The length frequencies were then divided accordingly.

The spatial and temporal heterogeneities of the proportions at length were examined using a two way anova without interaction (strata by year) using the RV biological data from 1984-1987. Proportions were estimated for 5 cm intervals of length to give reasonable sample sizes. The proportions were transformed using the arcsine transform suggested by Sokal and Rohlf (1981) for this type of data. The model was significant only at length intervals 31-35cm and 36-40cm (Table 15). Within these categories there were no significant year effects. Area effects were significant in both length groups (Table 15). Multiple comparisons using the Tukey-Kramer test (Sokal and Rohlf 1981) showed no significant differences among strata in the 36-40 cm length group. In the 31-35 cm length group stratum 38 was significantly different from strata 415, 431 and 420. When stratum means were ranked relative to stratum 438 a southwestern grouping, composed of strata 403, 432-434, 436-439, was apparent. This pattern is consistent with the hypothesis that there might be two stocks in Division 4T (Tallman 1990, Halliday et al. 1989, Powles 1965, 1969). Therefore, we divided the Division into two regions composed of the above strata and the rest of the area. The percent of each sex was applied to the length frequencies caught for each geographical unit.

The fleet does not fish with uniform intensity in all areas. For each NAFO unit area, the mean number per tow of each stratum in the unit area was multiplied by the proportion of the unit area that the stratum occupied. A total for each unit area was calculated by summing numbers within each. The theoretical population distribution in each unit area was weighted by the percentage of commercial fishery landings.

To summarize mathematically:

for "i" strata and "j" unit areas

Theoretical length

frequency distribution $= \sum_{j}\sum_{i} N_i P_{ji} Q_j$

where:

N_i = mean number per tow in stratum "i"

P_{ji} = proportion of unit area "j" that is made up of stratum "i"

Q_j = proportion of catch that is from unit area "j"

We will use the terms "theoretical catch" to describe the catch calculated from RV data that is unscaled to landings and "catch" to describe the catch derived from the addition of the discards calculated from the RV data to the commercial landings calculated using AGELEN (Wright 1990).

A theoretical distribution of catch at length for a given mesh size was calculated by applying a selectivity ogive (Table 2) to the sexed length frequency distribution. Ogives varied according to the year to correspond to the mesh size regulation at the time. The standard mesh size limit for mobile gear was 110mm in 1976, 120mm from 1977 to 1980 and 130mm from 1981 to the present (Clay et al. 1984). The ogives used were those calculated by Clay et al. (1984).

The resulting theoretical catch at length distribution was scaled to the landings by the ratio of the area under the curve of landings to that of theoretical catch. The domain of the scaling factor was chosen to reflect lengths above which the research vessel catch and the commercial catch would be unbiased by differential availability of American plaice to the net and the discarding practices. Chouinard and Metuzals (1985) found that less than 5% of the numbers caught were discarded in the 40 cm length group. Halliday et al. (1989) suggested that the majority of fish 35cm and below were discarded. To be as conservative as possible a lower bound of 40 cm was chosen. An upper bound of length was chosen (60 cm) beyond which it was thought that sampling would be sporadic. This figure was used to

scale the length frequency of the theoretical catch to the landings.

The following calculations were made on the lengths below 40 cm of the scaled estimated catch. The landings at length were assumed to be the minimum appropriate estimate of catch. To estimate discards, the landings at length were subtracted from the catch at length. Age-length keys for the new length frequency of the catch (<40 cm) were made for each sex using a program written in the SAS language. The length frequency of the discards of each sex was used with the appropriate age-length key calculated from the RV data to obtain the discards at age by sex. The estimated discarded catch and the landings were summed to give an estimated catch at age.

The discards at age for 1976 to 1989 are shown in Table 16. As one would expect the range of lengths is less than the landings at age but the number of ages where discarding occurs is broad (on average ages 4 to 15).

The catch at age including discards is shown in Table 17. While some of the increases appear rather large the discarding rate of roughly 83.5 per cent in numbers in 1976 corresponds well with the value of 76 per cent given by Halliday et al. (1989) for that year. The estimate of 66 % discarded catch by numbers is close to the 61.8 % recorded by Chouinard and Metuzals (1985) for 1984. The calculated value for 1980 of 59 % may be compared to 45.8 % recorded by Cliche (1981). When I limited the discard estimates to the unit areas surveyed by Cliche (areas 4Tf, 4Tk, 4Tl, 4Tn) the overall rate was 46 %.

The inclusion of discards improves the consistency in the matrix compared to the landings at age. The ages of full recruitment appears to be between ages 7 to 9 compared to 12 or 13 for the landings at age matrix.

Commercial Catch Rates

Tallman and Sinclair (1988) used catch rates to judge relative changes in stock size of the American plaice stock in NAFO Division 4T. However, we deem the catch rate series to be unreliable as an indicator of stock size because the fleets participating in both the American plaice directed and cod directed fisheries are thought to change as a function of stock size. Catch rates are calculated here for illustrative purposes. Separate catch rates were calculated for the American plaice directed (1977-1989) and cod directed (1966-1989) fisheries as well as the two groups combined (1966-1989). Gears used were restricted to otter trawls and Danish seiners. The two gears account for over 84% of the reported catch in the fishery and well over 95% of the available catch rate data. The 1984-85 data were revised according to 1984 NAFO statistics and 1985 regional

data respectively. Observations with less than 10 units of effort were removed. Months with less than 10 observations through the series were deleted in the combined run. A multiplicative model was used to calculate a standardized catch rate index for each gear (Gavaris 1980).

Observations were allocated to categories of gear/tonnage class/NAFO country code, month and year in the American plaice directed and cod directed runs. Observations in the combined run were allocated to categories of gear/tonnage class/NAFO country code, American plaice or cod directed fishery, month, and year. In all runs country codes 27 and 28 (Maritimes and Quebec,respectively) were combined into code 2 (the former Maritimes-Quebec code).

The analysis of variance tables and regression coefficient from the three runs are shown in the appendix 2 (Tables A, C, E). For the American plaice directed fishery, the model accounted for 40% of the variation and each category was significant. The model accounted for 63% and 47% of the variation in the cod directed and combined runs and in each case all categories were significant. Plots of the residuals of each run are shown in the appendix 2, Figures A, B and C. In each case the residuals appear to be randomly distributed. The residual distribution did not indicate heteroscedasticity, consequently weighting was not used.

Catch rate in all models declined from 1987 to 1988 and are well below historical catch rates of the late 1970s and 1960s (Appendix 2, Tables B, D, F and Figures D,E and F).

The cod by-catch and combined indices were rejected as useful indices of abundance on the grounds that sampling for American plaice would not cover the same time periods or locations from year to year due to closures in the cod fishery in recent years. Also, these indices might involve different components of the fleet in different years. Similarly, the American plaice directed index was not used in assessment because the vessels participating change depending on the cod fishery and the relative success rate in the American plaice fishery. However, it is interesting that the trend in catch rates is downward and follows the results of the RV survey analysis.

Research Survey Data

In 1986, the research vessel E.E. Prince was replaced by the Lady Hammond to conduct the fall groundfish survey in the southern Gulf of St. Lawrence. A comparative fishing experiment between the two vessels had been conducted in the 1985 survey to determine conversion factors. The CAFSAC Statistics, Sampling

and Surveys Sub-committee recommended that the catch per tow of American plaice from the E.E. Prince be multiplied by a factor of 1.8 to be made comparable to the new survey estimates from the Lady Hammond. The numbers at age for 1971 through to 1985 were adjusted by the conversion factor.

In addition to the change of survey vessels, a change was made to the survey design. In 1984 the random Stratified Station design was replaced by a fixed survey with random initial allocation of stations. From this point onward the index was calculated from a consistent set of 61 fixed stations. A constant trawlable unit size was used for both vessels.

From 1984 to 1986 length frequency sampling was conducted on sexes combined. Sexed length frequencies were resumed in 1987.

The sum of the mean numbers per tow at age from 1971-1989 are shown in Figure 3. Mean numbers per tow at age are presented in Table 18. The pattern of the mean numbers per tow reflects the high abundance at the end of the 1970s. The numbers per tow for 1986, 1987, 1988 and 1989 are the lowest in the series.

The mean numbers per tow by strata showed that American plaice occur in abundance in particular strata. The most notable are strata 19, 22, 23, 29, 33, 34. The pattern of distribution is relatively constant.

ESTIMATION OF PARAMETERS

A) Mortality from the Survey

Total mortality, Z, at age was calculated for the period using catch curve analysis (Ricker 1975) with consecutive ages of a cohort (Table 19). While these were variable from year to year there were generally higher total mortalities in the 1980s than in the 1970s as indicated by averages in Table 20. Also the total mortalities at age increased to about age 8 but were relatively constant to age 18. Estimates of older age abundance were not available at this time because sampling was limited in those age groups. The average age 8-18 values of Z were 0.36 for 1971-79 and 0.56 for 1980-88. $F_{0.1}$ for this stock is estimated to be 0.2 with M assumed to be 0.2. Thus, fishing mortalities have been above the target in recent years.

The standard errors for the RV survey from 1971 to 1989 are shown Table 21. The coefficients of variation are shown in Table 22.

RV mean number per tow for plus groups are shown in Table 23. Total mortalities using plus groups were calculated to smooth the total mortalities (Table 24).

B) Fishable Biomass

Total biomass was estimated from the RV survey from 1984 to 1989 by combining the biomass of the males, females, and juvenile American plaice. This period was chosen because there was relative stability in the mean number per tow. Biomass for each sex was estimated by multiplying the weighted average weight at age times the numbers at age.

The biomass of age 10 plus fish for the years 1988 to 1989 was estimated by combining the age 10+ biomass estimates of the males, females and juveniles (Table 25).

C) Yield per Recruit

Yield per recruit was calculated using the mean weight at age from the RV survey (ages 4 to 20) for 1983 to 1989 and a preliminary estimate of partial recruitment (calculated using the MULTPR function (S. Gavaris, Dept. of Fisheries and Oceans, St. Andrews Biological Station, St. Andrews, N.B. pers comm.) on preliminary estimates of fishing mortality from 1983 to 1987. The 1983 to 1987 time period was chosen because there was a change in mesh size regulations in 1982. The $F_{0.1}$ level was 0.32 and the F_{max} was 1.50 (Table 26).

$F_{0.1}$ = 0.3183 $F_{0.1}$ Yield = 0.075 kg Ave Wt. = 0.276 kg

F_{max} = 1.5000 F_{max} Yield = 0.105 kg Ave Wt. = 0.231 kg

D) SPA Calibration Adaptive Framework

SPA was calibrated using the adaptive framework (Gavaris 1988). The parameters estimated were 1) the size of the age classes 4 to 14 in 1989, 2) the slopes of the lines relating RV mean numbers per tow at age 4 to 14 and , 3) the catchability coefficient. Constraints on the parameters were placed on the initial analysis but were removed for the final run. The parameter estimates and their standard errors and the weighted residuals are presented in Table 27. Examination of the correlation matrix of the parameters showed that most correlations were between minus or plus 0.05 to 0.15 (Table 28). However, there were some correlations as high as 0.38. Age by age plots are shown in appendix 2. The residuals are highest in the late 1970s when population numbers were high. In recent years the residuals are close to the line.

E) Estimation of Total Allowable Catch

The RV survey has relatively low coefficients of variation (Table 22). Mortality estimates from the survey could be used to calculate biomass and thence a TAC.

The approach using age dis-aggregated total mortality estimates was as follows: The estimated average fishing mortality from age 8 to 18 is approximately 0.33. The abundance indices from both the RV survey and the commercial catch rates indicate relative stability in the population in the 1980s. The average catch over the same period has been 7,454 t. using the catch equations the biomass (B) may be estimated as:

$$B = \frac{C \; Z}{F \; (1 - e^{-Z})}$$

$$= 28{,}503 \text{ t}$$

where, C = average catch (7,454 t)

Z = current total mortality (0.53)

assuming M = 0.2 then

F = current fishing mortality (0.33)

Therefore one could estimate the $F_{0.1}$ catch as

$$C = \frac{F_{0.1} \; B \; (1 - e^{-Z0.1})}{Z_{0.1}}$$

$$= 4{,}699 \text{ t}$$

With $F_{0.1} = 0.2$

$Z_{0.1} = 0.4$

This estimate is made with the assumption that biomass has been relatively stable in the recent past, the age structure is stable, recruitment has been stable and there is no changes in the partial recruitment.

Another estimate using the same method but with age aggregated plus groups gave a yield of 7,454 t (average total Z from ages

12 and 13 = 0.40, average total F = 0.20).

An alternative method which approximates fishing at $F_{0.1}$ is to multiply the fishable biomass by 0.15 (D. Rivard, DFO, Ottawa, pers. comm.). Using this method with the age 10+ biomass from 1987 and 1988 the projected yield is 3,649 t.

PROGNOSIS

Catch rates are lower in recent years than during the late 1970s and the survey mean number per tow in 1989 is the lowest recorded. Estimates of F indicate levels in excess of F0.1. The status quo projection suggests that fishing at $F_{0.1}$ would require a reduction in the TAC to between 5,000 and 7,500 t. Fifteen per cent of the fishable biomass suggests an even lower TAC of approximately 3,650 t. Given the concordance of all the indices a more appropriate TAC for this stock at this time is between 3,000 and 8,000 t. However, discarding continues to be a serious problem with this stock. A TAC that is restrictive to the fishery, such as 4,000 t, may result in more fish being discarded and no conservation gains from the reduction in landings.

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REFERENCES

Chouinard , G.A., L. Currie and J. Murphy. 1987. Re-examination of 4T-Vn (Jan-Apr) cod otoliths for the period 1982-1985. (Including a report of the 4T-Vn (Jan-Apr) cod ageing workshop held in June 22-24, 1987 in Moncton, N.B.) CAFSAC Res. Doc. 87/99.

Chouinard, G.A. and K.I. Metuzals. 1985. Discards of cod (Gadus morhua) and American plaice (Hippoglossoides platessiodes) in NAFO Division 4T during 1984. C.A.F.S.A.C. Res. Doc. 85/84

Clay, D. 1979. current mesh selection studies on the Scotian Shelf in relation to historical selectivity data. ICNAF Sel. Papers No. 5: 49-60.

Clay, D. 1990. Seasonal distribution of demersal fish in the southern Gulf of St. Lawrence. IN: J.C. Therriault (Ed.) Symposium on the Gulf of St. Lawrence. Can. Fish. Aquat. Sci. Bulletin IN PRESS.

Clay, D. , G. Chouinard, T. Hurlbut, L. Currie and H. Clay. 1984. Stock report for American plaice, Hippoglossoides platessoides (Fabricus) and other flatfishes in the Gulf of St. Lawrence, including a discussion of discard levels and mesh selectivity of plaice. C.A.F.S.A.C. Res. Doc. 84/76.

Cliche, G. 1981. Rejets a la mer en 1980 des chalutiers Quebecois pechant en 4T. CAFSAC Res. Doc. 81/67.

Gavaris, S. 1980. Use of the multiplicative model to estimate catch rate and effort from commercial data. Can. J. Fish. Aquat. Sci. 37: 2272-2275.

Halliday, R.G. and A.C. Kohler 1971. Groundfish survey programs of the St. Andrews Biological Station, Fisheries Research Board of Canada - objectives and characteristics. ICNAF Res. Doc. No. 35, Ser. No. 2520, 25 p.

---------- and P.A. Koeller 1981. A history of Canadian groundfish trawling surveys and data usage in ICNAF Divisions 4TVWX. In: W.G. Doubleday and D. Rivard (eds.) Bottom trawl surveys. Can. Spec. Pub. Fish. Aquat. Sci. 58: 27-41.

Halliday, R.G., D.E. Hay and K.I. Metuzals 1989. Wastage at sea of American plaice (Hippoglossoides platessoides (Fabricus)) in the southern Gulf of St. Lawrence fishery in the 1970s. Can. Tech. Rep. of Fisheries and Aquatic Sciences No. 1663.

Powles, P.M. 1969. Size changes, mortality, and equilibrium yields in an exploited stock of American plaice (Hippoglossoides platessoides). J. Fish. Res. Bd. Canada 26: 1205-1235.

Ricker, W.E. 1975. Computation and interpretation of biological statistics of fish populations. Fisheries Research Board Bulletin 191. 382 p.

Sokal, R. and J. Rohlf. 1981. Biometry. 2nd Edition Freeman and Company, New York. 859 p.

Tallman, R.F. 1988. MS Report for the 4T American plaice ageing workshop held December 14-15, 1987 in Moncton, N.B. 45p. (unpublished report).

Tallman, R. and A. Sinclair. 1988. Assessment of 4T American plaice. C.A.F.S.A.C. Res. Doc. 88/45.

---------- 1989. Stock assessment of American plaice, Hippoglossoides platessiodes, in NAFO Division 4T. C.A.F.S.A.C. Res. Doc. 89/79.

Tallman, R.F. 1990. Causes of a within season decline in size at age in American plaice in NAFO Division 4T. IN: J.C. Therriault (Ed.) Symposium on the Gulf of St. Lawrence. Can. Fish. Aquat. Sci. Bulletin IN PRESS.

Table 1. Reported landings (t) of 4T American plaice from 1965-1989 by major gear types.

YEAR	OTB	OTB-1	OTB-2	SNU	GN	LL	LHP	OTHERS	TOTAL
1965	7782	-	-	1854	388	212	-	149	10385
1966	-	8066	581	2322	375	2	-	434	11780
1967	-	7237	211	1151	326	117	50	259	9351
1968	-	7900	237	913	298	4	36	180	9568
1969	-	5609	425	1418	421	58	17	244	8192
1970	29	5793	477	2243	439	79	7	134	9201
1971	-	4996	409	2885	876	21	9	317	9513
1972	14	4275	860	2576	286	73	11	199	8294
1973	20	3087	471	2748	241	73	1	406	7047
1974	0	3556	585	3719	250	6	5	364	8485
1975	1	3207	795	3897	217	14	18	294	8443
1976	41	4097	2864	3395	225	2	6	562	11192
1977	35	4261	375	4015	242	16	17	359	9320
1978	58	3651	889	3495	379	42	38	479	9031
1979	83	3415	961	3719	721	9	17	1161	10086
1980	1485	1809	558	3500	717	55	5	163	8292
1981	1022	1311	290	3575	1084	98	2	452	7834
1982	742	580	137	4124	805	94	5	55	6542
1983	821	479	102	4095	494	76	10	17	6094
1984	235	601	2582	3702	1905	386	25	191	9627
1985	165	824	3027	3870	1007	404	29	164	9490
1986	74	768	2125	3089	640	308	44	127	7175
1987*	0	986	2057	3078	800	619	73	181	7794
1988*	-	490	2017	2741	853	491	26	89	6707
1989*	-	498	1433	2271	548	190	21	26	4987
AVERAGE	504	3100	979	2976	581	138	19	280	8577

*(PROVISIONAL DATA)
(gear types: OTB=Otter Trawls (unspecified), OTB1=Otter Trawl-side, OTB2=Otter Trawl stern, SNU= Seines, GN=Gillnets, LL=Longlines, LHP=Handlines)

Table 2. Provisional landings (t) for 1989 by gear and month.

	MONTH												
GEAR	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
OTB1	-	-		14.4	29.8	98.7	93.2	63.7	80.8	84.5	32.5	0.0	497.7
OTB2	0	0.1	-	14.8	192.4	186.2	254.3	282.0	256.6	213.1	33.0	0.3	1432.8
TXS	-	-	0.8	1.7	5.8	0.4	0.8	0.5	0.5	0	4.8		15.3
SDN	-	-	-	37.5	323.0	295.6	140.5	173.4	199.1	314.0	84.8	-	1567.9
SSC	-	-	-	5.4	89.1	89.6	76.0	70.4	81.0	93.1	35.9	-	540.4
PS	-	-	-	-	-	-	-	-	0	0	0	-	0
SPR	-	-	-	0.1	22.8	86.1	27.5	17.8	3.1	5.6	0	-	163.0
GNS	0	-	0	11.8	111.4	134.0	122.6	81.2	63.0	22.4	1.6	0	548.1
GND	-	-	-	0	0	0	-	0	0	0	-	-	0
LLS	-	-	-	0.3	18.7	53.5	38.6	42.2	17.9	15.5	3.6	0	190.3
LHP	-	-	-	-	0.4	0.1	0.1	0.1	0	0	0.2	-	0.9
LH	0	-	-	-	3.3	5.8	5.9	2.9	1.4	0.5	0.8	-	20.7
FPN	0	-	-	-	0	0	0	1.2	3.3	1.9	-	-	6.4
FPO	-	-	-	-	0	0	0	-	-	-	-	-	0
NK	-	-	-	-	0	3.2	0.1	0.3	0.2	-	-	-	3.8
TOT	0	0.1	0.8	86.0	796.6	953.1	759.7	735.7	707.1	750.7	197.2	0.3	4987.3

* Values of 0 indicate landings of less than 50 Kg. - Indicate no landings. (Gear types: OTB1= otter trawl-side, OTB2= otter trawl-stern, PTB= bottom pair trawl, TXS= shrimp trawl, SDN= danish seine, SSC= scottish seine, PS= pair seine, SPR= pair seine(2 boats), GNS= gillnet set, GND= drift gillnet, LLS= set lines, LHP= handlines, LH= handlines with bait, FPN= uncovered pound nets, FPO= covered pots.)

Table 3. Commercial flatfish reported landings (t) in NAFO Divisions 4RST from 1963 to 1989

YEAR	YELLOW TAIL	ATLANTIC HALIBUT	GREEN. HALIBUT	WITCH	WINTER FLOUNDER	AMER. PLAICE	UNSPEC. FLOUNDER	TOTAL FLATFISH
1963	107	537	-	4250	3165	8470	-	16529
1964	65	615	-	3350	3014	8803	9	15856
1965	53	693	24	3608	4419	11098	5	19900
1966	157	612	365	3712	3136	12720	-	20702
1967	79	460	365	2714	2454	10497	24	16593
1968	12	444	689	3390	551	11932	-	17018
1969	268	510	802	4763	1710	10978	-	19031
1970	59	509	1112	4805	2694	13234	-	22413
1971	40	454	954	3821	2842	11770	-	19881
1972	3	310	683	2001	1911	9724	1373	16005
1973	6	385	763	2224	2384	8149	2426	16337
1974	27	418	1011	3247	1976	11261	999	18939
1975	3	272	1544	2722	2050	10177	3951	20719
1976	37	196	2019	6875	2471	14265	1785	27648
1977	30	150	3961	3036	1358	12755	1995	23285
1978	13	135	6247	4510	1236	12375	1196	25712
1979	69	132	8791	4561	1722	12933	894	29102
1980	46	202	7006	3527	2053	11115	1163	25112
1981	14	95	3176	1912	2013	10210	532	17952
1982	6	91	2269	1282	2339	8092	479	14558
1983	50	174	1105	1177	1799	8382	792	13479
1984	82	176	2126	1107	178	11790	65	15524
1985	212	164	2364	1824	1883	11366	2	17815
1986	418	313	6530	1831	3838	9348	-	22278
1987*	410	234	11047	2568	2263	9599	-	26121
1988*	222	255	7551	2657	1851	8706	-	21242
1989*	49	253	5122	2206	2596	6720	-	16946
AVERAGE	94	326	2774	3099	2219	10610	655	19777

(* PROVISIONAL DATA)

Table 4. The 1989 provisional flatfish reported catches (t) in the Gulf of St. Lawrence by NAFO division and province (See Figure 2).

	COUNTRY CODE	YELLOW TAIL	ATLANTIC HALIBUT	GREENLAND HALIBUT	WITCH	WINTER FLOUNDER	AMERICAN PLAICE
4R	CAN-M	1.3	1.2	67.6	164.5	0.1	116.6
	CAN-Q	0.0	7.8	4.3	0.0	0.0	7.1
	CAN-N	4.5	71.9	317.0	797.9	408.5	792.5
TOTAL 4R		5.8	80.9	388.9	962.4	408.6	916.2
4S	CAN-M	0.0	0.1	47.0	9.2	0.0	17.8
	CAN-Q	0.9	73.5	1814.2	90.9	210.3	797.0
	CAN-N	0.0	0.0	4.1	3.3	0.0	1.2
TOTAL 4S		0.9	73.6	1865.3	103.4	210.3	816.0
4T	CAN-M	38.2	13.1	2.9	856.4	1498.4	3271.8
	CAN-Q	3.8	85.4	2864.5	283.9	478.4	1709.9
	CAN-N	0.0	0.0	0.1	0.2	0.0	5.6
TOTAL 4T		42.0	98.5	2867.5	1140.5	1976.8	4987.3

(CAN-M = CANADA-MARITIMES, CAN-Q = CANADA-QUEBEC, CAN-N = CANADA-NEWFOUNDLAND)

Table 5. Resource allocation scheme for American plaice in Division 4T 1986-1989 (M.G. = mobile gear, F.G. = fixed gear).

YEAR	GEAR	FINAL ALLOCATION (tonnes)	CATCH (tonnes)	CLOSURE
1987	M.G (65-100')	500	306	none
	M.G (less than 65')	8000	6060	none
	F.G (less than 65')	1500	1071	none
1988	M.G (65-100')	500	602	none
	M.G (less than 65')	8000	5900	none
	F.G (less than 65')	1500	149	none
1989	M.G (65-100')	500	179	none
	M.G (45'-65')	3800	1506	none
	M.G (less than 45')	4200	2460	none
	F.G (less than 65')	1500	680	none
1990	M.G (65-100')	500		
	M.G (45-65')	3800		
	M.G (less than 45')	4200		
	F.G (less than 45')	1500		

Table 6. Commercial otoliths. (+ or - indicates bias)

Date (1990)	Comparison (% agreement) Reader vs reference	skewnesss	Comments
JAN 12	80	0.381806	
JAN 24	75	0.686993*	
JAN 31	82	-1.0202*	re-test
FEB 1	74	0.963192	re-test
FEB 6	82	-1.1455*	re-test
FEB 7	77	-0.772081	no skewness resumed ageing
MAR 5	78	-0.874529*	re-test
MAR 6	82	-0.384147	no skewness resumed ageing
MAR 15	74	-0.0690092	

* significant skewness (bias)

Table 7. NUMBERS OF AMERICAN PLAICE AGED AND MEASURED IN 1989

		MONTH								
		APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	TOTAL
GEAR										
GILLNETS	MEAS	30	228	.	83	.	.	.	.	341
	AGED	13	26	.	26	.	.	.	.	65
LONGLINE	MEAS	.	.	.	63	.	222	.	.	285
	AGED	.	.	.	34	.	47	.	.	81
SEINES	MEAS	.	1723	3182	1156	2563	919	1396	724	11663
	AGED	.	231	468	153	359	152	175	90	1628
TRAWLS	MEAS	.	375	1049	337	838	218	700	.	3517
	AGED	.	57	149	48	122	27	69	.	472
TOTAL	Number of samples	1	11	18	10	16	7	9	3	75

Table 8. Age-length table used in the calculation for 1976 to 1989 catch at age

YEAR	TABLE TYPE	GEARS	PERIOD		SAMPLE SIZE	CATCH	SEPARATED a male	SEPARATED a female	SEPARATED b male	SEPARATED b female
1976	ALK	ALL GEARS	JAN-DEC	LENGTH AGED	12042 2397	11193	.007393	.003696	3.0561	3.2636
	LF	(10,11,12,13)	JAN-DEC	LENGTH	3846	7150	.007393	.003696	3.0561	3.2636
	LF	(20,21,22,23)	JAN-DEC	LENGTH	7996	3395	.007393	.003696	3.0561	3.2636
1977	ALK	ALL GEARS	JAN-DEC	LENGTH AGED	10260 1800	9230	.004435	.002426	3.1900	3.3708
	LF	(10,11,12,13)	JAN-DEC	LENGTH	1906	4675	.004435	.002426	3.1900	3.3708
	LF	(20,21,22,23)	JAN-DEC	LENGTH	8354	4015	.004435	.002426	3.1900	3.3708
1978	ALK	ALL GEARS	JAN-DEC	LENGTH AGED	4725 794	9031	.002120	.0009928	3.3665	3.5945
	LF	(10,11,12,13)	JAN-DEC	LENGTH	945	4598	.002120	.0009928	3.3665	3.5945
	LF	(20,21,22,23)	JAN-DEC	LENGTH	3780	3495	.002120	.0009928	3.3665	3.5945
1979	ALK	ALL GEARS	JAN-DEC	LENGTH AGED	3383 596	9996	.0009339	.0006864	3.5957	3.6872
	LF	(10,11,12,13)	JAN-DEC	LENGTH	1578	4463	.0009339	.0006864	3.5957	3.6872
	LF	(20,21,22,23)	JAN-DEC	LENGTH	1605	3719	.0009339	.0006864	3.5957	3.6872
	LF	(41,51,53)	JAN-DEC	LENGTH	200	721	.0009339	.0006864	3.5957	3.6872
1980	ALK	ALL GEARS	JAN-DEC	LENGTH AGED	3055 441	8292	.007185	.003209	3.02359	3.2734
	LF	(10,11,12,13)	JAN-DEC	LENGTH	1210	3853	.007185	.003209	3.02359	3.2734
	LF	(21,22,23)	JAN-DEC	LENGTH	1642	3500	.007185	.003209	3.02359	3.2734
	LF	(40,41,42)	JAN-DEC	LENGTH	203	222	.007185	.003209	3.02359	3.2734

Table 8. Age-length table used in the calculation for 1976 to 1989 catch at age

YEAR	TABLE TYPE	GEARS	PERIOD		SAMPLE SIZE	CATCH	SEPARATED a male	SEPARATED a female	SEPARATED b male	SEPARATED b female
1981	ALK	ALL GEARS	JAN-DEC	LENGTH AGED	3713 541	7834	.008189	.004313	3.0009014	3.2004
	LF	(10,11,12,13)	JAN-DEC	LENGTH	987	2623	.008189	.004313	3.0009014	3.2004
	LF	(20,21,22,23)	JAN-DEC	LENGTH	2262	3575	.008189	.004313	3.0009014	3.2004
1982	ALK	ALL GEARS	JAN-DEC	LENGTH AGED	4108 562	6542	.012003	.004948	2.8914	3.1686
	LF	(10,11,12,13)	JAN-DEC	LENGTH	1624	1459	.012003	.004948	2.8914	3.1686
	LF	(20,21,22,23)	JAN-DEC	LENGTH	2441	4124	.012003	.004948	2.8914	3.1686
1983	ALK	ALL GEARS	JAN-DEC	LENGTH AGED	9280 980	6094	.009960	.002109	2.8802	3.3582
	LF	(10,11,12,13)	JAN-DEC	LENGTH	2345	1402	.009960	.002109	2.8802	3.3582
	LF	(20,21,22,23)	JAN-DEC	LENGTH	6001	4095	.009960	.002109	2.8802	3.3582
	LF	(40,41,42)	JAN-DEC	LENGTH	180	494	.009960	.002109	2.8802	3.3582
1984	ALK	ALL GEARS	JAN-DEC	LENGTH AGED	13335 639	9599	.004012	.002271	3.2042	3.3777
	LF	(10,11,12,13)	JAN-JULY	LENGTH	1536	1473	.004012	.002271	3.2042	3.3777
	LF	(20,21,22,23)	JAN-JULY	LENGTH	1924	1719	.004012	.002271	3.2042	3.3777
	LF	(40,41,42,50,51,52)	JAN-JULY	LENGTH	475	825	.004012	.002271	3.2042	3.3777
	LF	(10,11,12,13)	AUG-DEC	LENGTH	4576	1949	.004012	.002271	3.2042	3.3777
	LF	(20,21,22,23)	AUG-DEC	LENGTH	3328	1983	.004012	.002271	3.2042	3.3777
	LF	(40,41,42,50,51,52)	AUG-DEC	LENGTH	1496	1466	.004012	.002271	3.2042	3.3777

Table 8. Age-length table used in the calculation for 1976 to 1989 catch at age

YEAR	TABLE TYPE	GEARS	PERIOD		SAMPLE SIZE	CATCH	SEPARATED a male	SEPARATED a female	SEPARATED b male	SEPARATED b female
1985	ALK	ALL GEAR	JAN-JULY	LENGTH AGED	4111 938	4423	.003172	.002338	3.2905	3.3835
	ALK	ALL GEAR	AUG-DEC	LENGTH AGED	3378 612	5067	.003172	.002338	3.2905	3.3835
	LF	(10,11,12,16)	JAN-JULY	LENGTH	1306	1891	.003172	.002338	3.2905	3.3835
	LF	(21,22,23)	JAN-JULY	LENGTH	2263	1784	.003172	.002338	3.2905	3.3835
	LF	(41,42,51)	JAN-JULY	LENGTH	542	694	.003172	.002338	3.2905	3.3835
	LF	(10,11,12,16)	AUG-DEC	LENGTH	549	2208	.003172	.002338	3.2905	3.3835
	LF	(21,22,23)	AUG-DEC	LENGTH	2646	2086	.003172	.002338	3.2905	3.3835
	LF	(41,42,51)	AUG-DEC	LENGTH	183	717	.003172	.002338	3.2905	3.3835
1986	ALK	ALL GEARS	JAN-JULY	LENGTH AGED	11479 803	3961	.01070	.004858	2.9310	3.1875
	ALK	ALL GEARS	AUG-DEC	LENGTH AGED	8274 489	3252	.01070	.004858	2.9310	3.1875
	LF	(11,12,16)	JAN-JULY	LENGTH	2429	1524	.01070	.004858	2.9310	3.1875
	LF	(20)	JAN-JULY	LENGTH	7302	1921	.01070	.004858	2.9310	3.1875
	LF	(50)	JAN-JULY	LENGTH	1195	513	.01070	.004858	2.9310	3.1875
	LF	(11,12,16)	AUG-DEC	LENGTH	3784	1178	.01070	.004858	2.9310	3.1875
	LF	(20)	AUG-DEC	LENGTH	3901	1542	.01070	.004858	2.9310	3.1875
	LF	(50)	AUG-DEC	LENGTH	589	458	.01070	.004858	2.9310	3.1875

Table 8. Age-length table used in the calculation for 1976 to 1989 catch at age

YEAR	TABLE TYPE	GEARS	PERIOD		SAMPLE SIZE	CATCH	SEPARATED a male	SEPARATED a female	SEPARATED b male	SEPARATED b female
1987	ALK	ALL GEARS	JAN-JULY	LENGTH AGED	8680 923	4119	.0006390	.0021	3.7540	3.4010
	ALK	ALL GEARS	AUG-DEC	LENGTH AGED	10616 1445	3675	.0006390	.0021	3.7540	3.4010
	LF	(11,12,16)	JAN-JULY	LENGTH	1632	1706	.0006390	.0021	3.7540	3.4010
	LF	(20)	JAN-JULY	LENGTH	5628	1538	.0006390	.0021	3.7540	3.4010
	LF	(40&50)	JAN-JULY	LENGTH	1420	851	.0006390	.0021	3.7540	3.4010
	LF	(11,12,16)	AUG-DEC	LENGTH	2746	1473	.0006390	.0021	3.7540	3.4010
	LF	(20)	AUG-DEC	LENGTH	5692	1540	.0006390	.0021	3.7540	3.4010
	LF	(40&50)	AUG-DEC	LENGTH	2178	692	.0006390	.0021	3.7540	3.4010
1988	ALK	ALL GEARS	JAN-JULY	LENGTH AGED	9026 436	3352	.0010	.0013	3.5270	3.6280
	ALK	ALL GEARS	AUG-DEC	LENGTH AGED	8585 523	3355	.0010	.0013	3.5270	3.6280
	LF	(11,12,15,16)	JAN-JULY	LENGTH	2520	847	.0010	.0013	3.5270	3.6280
	LF	(21,22,23,31,33)	JAN-JULY	LENGTH	4906	1559	.0010	.0013	3.5270	3.6280
	LF	(41,42,51)	JAN-JULY	LENGTH	1600	918	.0010	.0013	3.5270	3.6280
	LF	(11,12,15,16)	AUG-DEC	LENGTH	1518	1721	.0010	.0013	3.5270	3.6280
	LF	(21,22,23,31,33)	AUG-DEC	LENGTH	6765	1181	.0010	.0013	3.5270	3.6280
	LF	(41,42,51)	AUG-DEC	LENGTH	302	27	.0010	.0013	3.5270	3.6280

Table 8. Age-length table used in the calculation for 1976 to 1989 catch at age

YEAR	TABLE TYPE	GEARS	PERIOD		SAMPLE SIZE	CATCH	SEPARATED a male	SEPARATED a female	SEPARATED b male	SEPARATED b female
1989	ALK	ALL GEARS	JAN-JULY	LENGTH	8226	2596	.003868	.003322	3.2276	3.2730
				AGED	1205					
	ALK	ALL GEARS	AUG-DEC	LENGTH	7580	2391	.003868	.003322	3.2276	3.2730
				AGED	1041					
	LF	(11,12,16)	JAN-JULY	LENGTH	1761	884	.003868	.003322	3.2276	3.2730
	LF	(21,22,23)	JAN-JULY	LENGTH	6061	1193	.003868	.003322	3.2276	3.2730
	LF	(41,50,51)	JAN-JULY	LENGTH	404	4909	.003868	.003322	3.2276	3.2730
	LF	(11,12,16)	AUG-DEC	LENGTH	1756	1047	.003868	.003322	3.2276	3.2730
	LF	(21,22,23)	AUG-DEC	LENGTH	5602	1078	.003868	.003322	3.2276	3.2730
	LF	(41,50,51)	AUG-DEC	LENGTH	222	247	.003868	.003322	3.2276	3.2730

(Gear types: 10=Otter trawl, 11=Otter trawl-side, 12=Otter trawl-stern, 13=Midwater trawl, 16=Bottom pair trawl, 20=Danish seine (charters), 21=Danish seine, 22=Scottish seine, 23=Pair seine, 31=Purse seine, 33=Purse seine-2 vessels, 40=Gillnets, 41=Set Gillnets, 42=Drift gillnets, 50=Longlines, 51=set lines, 52=Drift lines.)

Table 9. LANDINGS AT AGE ('000's) OF NAFO DIVISION 4T AMERICAN PLAICE BY GEAR AND SEASON FOR 1989

	JAN-JULY			AUG-DEC				
AGE	OTB	SEINES	GN&LL	OTB	SEINES	GN&LL	TOTAL CATCH	WEIGHTED CATCH
1	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.00
2	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.00
3	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.00
4	5.531	2.893	2.244	0.000	0.000	0.000	10.67	10.77
5	21.314	13.580	0.516	37.526	18.720	0.000	91.66	92.53
6	98.086	54.360	16.432	137.541	70.256	0.324	377.00	380.58
7	256.793	150.196	51.889	289.498	161.613	2.505	912.49	921.17
8	281.448	155.982	75.769	386.022	206.022	2.911	1108.15	1118.69
9	408.541	234.331	136.811	461.730	267.493	7.637	1516.54	1530.97
10	269.397	162.563	113.285	289.690	166.440	7.386	1008.76	1018.35
11	217.055	142.193	98.965	216.792	134.481	10.470	819.96	827.75
12	171.393	125.546	93.523	157.404	103.696	11.523	663.09	669.39
13	117.661	109.937	69.184	145.622	111.584	17.186	571.17	576.61
14	83.091	92.084	53.672	100.452	90.512	19.342	439.15	443.33
15	65.385	95.755	51.429	74.744	79.833	19.764	386.91	390.59
16	42.913	112.789	43.582	50.085	74.404	25.871	349.64	352.97
17	27.170	70.246	22.738	28.113	67.632	25.790	241.69	243.99
18	15.882	73.154	15.333	16.703	53.599	23.054	197.73	199.61
19	6.453	34.276	6.242	2.539	24.772	10.520	84.80	85.61
20	5.373	32.374	5.427	7.199	25.514	10.815	86.70	87.53
21	4.330	19.623	4.402	2.499	18.117	6.461	55.43	55.96
22	2.250	16.539	1.945	0.331	6.887	2.259	30.21	30.50
23	1.029	6.251	1.037	0.226	6.776	2.394	17.71	17.88
24	0.088	0.913	0.446	0.127	3.275	1.337	6.19	6.24
25	0.000	0.000	0.000	0.255	4.225	1.489	5.97	6.03
26	0.000	1.282	0.000	0.118	1.059	0.543	3.00	3.03

TABLE 10. VARIANCE AT AGE OF ESTIMATED LANDINGS OF NAFO DIVISION 4T AMERICAN PLAICE BY GEAR AND SEASON FOR 1989

	JAN-JULY			AUG-DEC			
AGE	OTB	SEINES	GN&LL	OTB	SEINES	GN&LL	TOTAL
1	0.00	0.000	0.000	0.00	0.000	0.000	0.00
2	0.00	0.000	0.000	0.00	0.000	0.000	0.00
3	0.00	0.000	0.000	0.00	0.000	0.000	0.00
4	30.75	8.388	5.147	0.00	0.000	0.000	44.28
5	64.89	29.911	0.184	162.20	45.679	0.000	302.86
6	367.84	124.403	23.658	808.33	192.155	0.049	1516.44
7	1032.44	338.318	79.091	1492.09	412.318	0.901	3355.16
8	1112.76	341.212	111.339	1822.80	499.570	0.538	3888.22
9	1478.23	461.751	195.961	1999.35	607.259	2.065	4744.61
10	860.62	276.171	150.995	1243.82	387.076	1.804	2920.49
11	753.56	254.353	130.174	811.85	271.442	3.591	2224.97
12	444.36	172.291	104.425	586.05	204.565	4.741	1516.43
13	366.31	170.986	83.539	389.12	177.416	7.312	1194.68
14	183.04	119.768	55.890	287.83	145.247	10.036	801.81
15	137.95	123.007	49.256	190.59	116.360	9.557	626.72
16	58.83	135.645	41.981	111.90	92.608	14.236	455.20
17	47.58	91.273	20.609	30.78	77.476	14.292	282.01
18	21.84	102.205	12.065	31.12	63.021	13.815	244.07
19	3.07	44.312	3.761	1.17	23.648	6.494	82.45
20	2.20	46.343	3.122	7.85	28.994	6.804	95.32
21	2.26	26.472	3.017	1.12	18.841	3.679	55.39
22	0.69	21.046	0.814	0.08	6.566	1.321	30.51
23	0.33	8.268	0.618	0.04	7.328	1.318	17.91
24	0.02	0.472	0.294	0.03	2.692	0.662	4.17
25	0.00	0.000	0.000	0.08	3.075	0.798	3.95
26	0.00	0.639	0.000	0.02	0.792	0.457	1.91

TABLE 11. AVERAGE WEIGHT AT AGE OF NAFO DIVISION 4T AMERICAN PLAICE BY GEAR AND SEASON FOR 1989

SEX=MALES

	JAN-JULY			AUG-DEC		
AGE	OTB	SEINES	GN&LL	OTB	SEINES	GN&LL
1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
5	0.2215	0.2193	0.2518	0.2268	0.2564	0.0000
6	0.2487	0.2508	0.3115	0.2642	0.2603	0.0000
7	0.2806	0.2708	0.3139	0.2757	0.2715	0.3725
8	0.2740	0.2718	0.3387	0.3032	0.2817	0.4899
9	0.2907	0.2883	0.3394	0.3072	0.2988	0.4043
10	0.3040	0.3014	0.3773	0.3542	0.3259	0.9884
11	0.3430	0.3562	0.4025	0.3618	0.3289	0.4756
12	0.3626	0.3789	0.3813	0.3559	0.3450	0.6958
13	0.4046	0.4386	0.4027	0.3856	0.3771	0.5820
14	0.4299	0.5370	0.5072	0.4485	0.4850	0.6047
15	0.4338	0.5737	0.7825	0.5504	0.6524	0.7334
16	0.5521	0.6621	0.5811	0.4939	0.6258	0.8169
17	0.5022	0.5862	0.4990	0.4622	0.6242	0.5843
18	0.0000	0.0000	0.0000	0.0000	0.7796	0.7796
19	0.0000	1.1778	0.0000	0.0000	1.1065	0.0000
20	0.0000	0.9646	0.0000	0.7239	0.7239	0.0000
21	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
22	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
23	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
24	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
25	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
26	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

SEX=FEMALES

	JAN-JULY			AUG-DEC		
AGE	OTB	SEINES	GN&LL	OTB	SEINES	GN&LL
1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4	0.3760	0.3760	0.3760	0.0000	0.0000	0.0000
5	0.2147	0.2304	0.2527	0.2604	0.2491	0.0000
6	0.2874	0.3083	0.4073	0.3150	0.3124	0.3900
7	0.3067	0.3241	0.3779	0.3577	0.3663	0.7172
8	0.3495	0.3490	0.3963	0.3653	0.3756	0.4979
9	0.3695	0.3899	0.4255	0.4131	0.4355	0.6235
10	0.4342	0.4732	0.4816	0.4433	0.4694	0.6853
11	0.4313	0.5267	0.5177	0.5055	0.5740	0.8137
12	0.5185	0.7221	0.5941	0.5178	0.6365	0.9595
13	0.5196	0.7577	0.6502	0.6185	0.7727	0.9931
14	0.5963	0.8963	0.6916	0.6165	0.8340	1.1184
15	0.6703	1.0084	0.8001	0.6821	0.8622	1.0740
16	0.8643	1.1772	0.8881	0.7478	1.1022	1.2413
17	0.9210	1.3416	1.0429	0.9190	1.2180	1.2779
18	1.1333	1.4315	1.4030	0.8695	1.3163	1.3767
19	1.3923	1.5866	1.2627	1.4256	1.7288	1.6718
20	1.4886	1.5803	1.5112	1.0700	1.5248	1.4694
21	1.4334	1.6434	1.4506	1.3854	1.7090	1.6007
22	1.7425	1.7384	1.7020	1.6304	1.9395	1.9628
23	1.8055	1.6533	1.3504	1.6185	1.8185	1.7240
24	2.4429	2.3622	2.4429	1.8551	2.1372	2.0990
25	0.0000	0.0000	0.0000	1.8551	2.3257	2.1937
26	0.0000	2.6121	0.0000	1.9638	2.1558	2.7405

TABLE 12. AVERAGE LENGTH AT AGE OF NAFO DIVISION 4T AMERICAN PLAICE BY GEAR AND SEASON FOR 1989

SEX=MALES

	JAN-JULY			AUG-DEC		
AGE	OTB	SEINES	GN&LL	OTB	SEINES	GN&LL
1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
5	29.6794	29.6268	31.0000	29.5481	31.1229	0.0000
6	30.7630	30.8982	33.0615	31.3961	31.2037	0.0000
7	31.8880	31.5182	33.1363	31.7310	31.5972	35.0000
8	31.6615	31.5909	33.9021	32.6017	31.9011	37.8749
9	32.2893	32.1560	33.7971	32.7951	32.5577	35.8983
10	32.6588	32.5149	34.9313	34.1610	33.4245	46.3667
11	33.8919	34.1273	35.5650	34.3306	33.4128	37.5102
12	34.5545	34.9206	35.0966	34.1532	33.7984	42.2537
13	35.6946	36.4796	35.6338	34.9350	34.5822	40.0170
14	36.2722	38.6061	38.0856	36.6821	37.1960	40.5286
15	36.3923	39.2776	42.1636	39.2709	41.0566	43.0426
16	39.3588	41.6249	40.0589	38.0788	40.4560	44.4833
17	38.2596	40.0166	38.1646	37.2843	40.4900	39.9689
18	0.0000	0.0000	0.0000	0.0000	44.0000	44.0000
19	0.0000	50.0000	0.0000	0.0000	48.9570	0.0000
20	0.0000	47.0000	0.0000	43.0000	43.0000	0.0000
21	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
22	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
23	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
24	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
25	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
26	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

SEX=FEMALES

	JAN-JULY			AUG-DEC		
AGE	OTB	SEINES	GN&LL	OTB	SEINES	GN&LL
1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4	35.0000	35.0000	35.0000	0.0000	0.0000	0.0000
5	29.3926	30.0504	31.0000	31.2611	30.8159	0.0000
6	31.8682	32.5446	35.5297	33.0685	32.9478	35.2817
7	32.6602	32.9832	34.8369	34.2612	34.3576	41.6326
8	33.9963	33.9647	35.4205	34.4822	34.7461	37.9719
9	34.5786	34.9691	36.0960	35.7785	36.2398	40.4864
10	36.2995	37.0808	37.4443	36.5802	37.1628	41.6624
11	36.1008	37.9926	38.1069	37.9861	39.3444	43.9438
12	38.1635	41.7143	39.7439	38.1539	40.2941	46.0086
13	38.0166	42.2659	40.6610	40.4151	42.9269	46.6321
14	39.5071	44.4792	41.6832	40.3281	43.8195	48.3644
15	40.9765	46.3668	43.2847	41.4928	44.4196	47.8325
16	44.3117	48.9417	45.1078	42.4002	47.8425	50.0751
17	44.5228	50.8196	46.7024	45.5447	49.5541	50.5156
18	46.8073	51.9278	51.5829	44.5174	50.7306	51.7021
19	51.4542	53.8134	50.0796	52.3529	55.4851	54.9298
20	52.9084	53.8991	52.9846	47.5546	53.1449	52.7271
21	51.7209	54.3747	51.8013	51.7931	55.1680	54.1252
22	55.6539	55.6203	55.3072	54.6965	57.5211	57.4463
23	56.0780	54.5717	51.7002	54.6256	56.4649	55.5653
24	62.0000	61.3627	62.0000	57.0000	59.4285	59.1166
25	0.0000	0.0000	0.0000	57.0000	60.7224	59.7816
26	0.0000	63.1998	0.0000	58.0000	59.514	64.1251

Table 13. ESTIMATED LANDINGS AT AGE (,000) for 4T American Plaice from 1976 to 1989

AGE	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	3	9	2	0	0	0	4	46	18	0	1	23	11
5	37	99	242	0	0	0	0	128	195	89	25	48	60	93
6	457	601	776	473	81	41	25	177	356	92	397	139	232	381
7	1380	2101	2002	1202	615	190	46	286	798	464	769	483	234	921
8	2371	2253	3837	4682	1129	461	378	417	782	680	1322	527	484	1119
9	2142	1884	2671	5723	2771	717	1061	529	960	728	1349	574	768	1531
10	2400	1625	2612	3926	2640	1564	1682	843	1557	1161	1193	794	739	1018
11	2036	1295	2144	2379	2279	1190	1482	1107	1823	1664	1505	784	822	828
12	2818	1706	1470	1534	2722	1417	1489	1454	1628	2098	1677	868	980	669
13	1466	902	1383	1051	2322	944	1027	1476	1009	1769	1572	1094	800	577
14	796	594	720	988	1663	1314	735	873	1299	1560	1016	984	968	443
15	397	289	542	309	1586	2047	413	600	883	1112	798	958	828	391
16	407	231	144	209	713	949	324	468	459	817	551	699	789	352
17	334	201	102	127	462	1286	34	447	560	531	329	664	433	243
18	207	237	109	28	97	803	255	297	378	258	179	337	368	200
19	267	157	66	57	106	203	43	338	267	297	162	315	232	86
20	165	171	33	44	133	280	24	115	197	138	136	295	205	88
21	98	44	95	71	39	221	73	74	57	70	119	164	81	56
22	75	20	0	17	0	0	35	105	24	60	34	118	73	31
23	26	10	113	7	0	0	27	17	18	28	25	87	47	18
24	14	17	29	0	0	0	11	3	0	15	18	45	50	6
25	11	0	0	14	0	0	6	16	0	20	6	24	24	6
26	6	14	15	0	0	0	2	11	0	0	6	26	0	3
TOTAL	17921	14822	19124	22843	19358	13627	9488	9796	13296	13669	13188	10028	9240	9071

Table 14. CV (/100) FOR LANDINGS OF 4T PLAICE FROM 1976 TO 1989.

AGE	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
4	0	0	0	0	0	0.847	0	0	0.126	0.198	0	0.000	0.043	0.030
5	0.313	0.185	0.365	0	0	0.387	0	0.076	0.299	0.193	0.273	0.188	0.132	0.066
6	0.118	0.128	0.234	0.290	0.820	0.340	0.398	0.140	0.210	0.198	0.172	0.116	0.157	0.042
7	0.071	0.079	0.129	0.153	0.204	0.268	0.413	0.133	0.070	0.106	0.122	0.062	0.140	0.040
8	0.054	0.079	0.096	0.081	0.152	0.167	0.174	0.110	0.097	0.088	0.082	0.062	0.097	0.027
9	0.058	0.085	0.128	0.072	0.097	0.132	0.105	0.108	0.082	0.087	0.087	0.059	0.084	0.026
10	0.053	0.086	0.118	0.082	0.116	0.107	0.077	0.086	0.068	0.069	0.078	0.050	0.081	0.020
11	0.056	0.091	0.129	0.110	0.125	0.082	0.088	0.081	0.062	0.054	0.073	0.050	0.074	0.025
12	0.044	0.064	0.139	0.130	0.110	0.118	0.092	0.072	0.064	0.047	0.063	0.049	0.069	0.021
13	0.059	0.081	0.151	0.139	0.136	0.143	0.115	0.076	0.075	0.048	0.059	0.041	0.077	0.025
14	0.074	0.086	0.116	0.127	0.171	0.128	0.132	0.102	0.074	0.052	0.071	0.043	0.068	0.025
15	0.093	0.082	0.161	0.179	0.175	0.118	0.177	0.139	0.094	0.056	0.067	0.044	0.072	0.026
16	0.081	0.093	0.324	0.216	0.197	0.149	0.203	0.169	0.194	0.066	0.069	0.049	0.071	0.031
17	0.087	0.089	0.481	0.219	0.274	0.140	0.193	0.172	0.183	0.078	0.084	0.049	0.104	0.032
18	0.108	0.092	0.307	0.446	0.431	0.171	0.220	0.219	0.199	0.109	0.112	0.066	0.123	0.041
19	0.095	0.107	0.362	0.388	0.482	0.297	0.489	0.207	0.223	0.111	0.101	0.068	0.151	0.046
20	0.117	0.087	0.551	0.422	0.703	0.331	0.560	0.333	0.310	0.174	0.127	0.07	0.174	0.036
21	0.153	0.220	0.236	0.401	0	0.231	0.422	0.333	0.577	0.237	0.122	0.093	0.265	0.036
22	0.197	0.311	0	0.589	0.281	0.244	0.400	0.352	0.739	0.252	0.166	0.103	0.274	0.052
23	0.282	0.406	0.308	0.885	0.618	0.389	0.687	0.672	0.661	0.486	0.215	0.122	0.346	0.020
24	0.369	0.314	0.379	0	0	0.297	0.960	0.970	0	0.522	0.202	0.176	0.390	0.029
25	0.353	0	0	0.586	0	0.597	0.769	0.711	0	0.615	0.271	0.211	0.504	0.036
26	0.577	0.317	0.508	0	0	0.457	0	0.914	0	0	0.370	0.245	0	0.059
27	0	0	0	0	0	0	0	0	0	0	0.000	0.253	0	0.021
28	0	0	0	0	0	0	0	0	0	0	0.822	0.284	0	0.040
29	0	0	0	0	0	0	0	0	0	2.995	0.385	0.220	0	0
30	0	0	0	0	0	0	0	0	0	0	0.305	0.000	1.243	0.010

Table 16. NAFO Division 4T American plaice discards at age ('000) for 1976 to 1989.

AGE	YEAR 1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	47	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	69	0	68	0	0	124
4	1521	322	217	98	179	166	32	168	217	444	716	159	115	399
5	14303	4445	1318	722	951	384	738	1022	610	1663	1370	1539	893	2396
6	29268	12192	3646	2983	2714	2663	1300	3235	1560	2146	3107	5968	4000	4718
7	19802	17997	8130	6894	7424	5861	3219	3629	2854	2832	4622	8971	3954	10080
8	9635	9249	5823	7202	9572	7505	6754	7089	3446	3832	3313	8673	5826	8273
9	8262	3395	1711	3141	4825	7063	5742	10569	4625	3177	3227	7708	3995	6866
10	5020	1640	979	1094	1942	4925	4287	7758	6018	3136	1868	6370	1862	4972
11	2524	791	388	438	469	2165	1458	9142	2531	3750	2334	5410	1452	2565
12	953	385	59	158	157	997	202	4494	2371	2935	3703	4618	1224	2341
13	0	103	27	45	75	103	8	1037	1010	2211	2253	2134	1011	1571
14	223	0	0	12	27	75	0	278	223	1746	1640	1753	971	1066
15	49	23	0	1	0	150	14	93	39	615	874	911	328	549
16	0	8	0	0	0	0	0	0	0	300	584	474	47	220
17	30	0	0	0	0	0	0	36	11	139	268	142	40	108
18	0	0	0	0	0	0	0	0	0	109	23	0	3	4
19	0	0	0	0	0	0	0	0	0	39	43	0	0	0
20	0	0	0	0	0	0	0	0	0	19	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	91590	50550	22298	22788	28335	32057	23754	48597	25584	29093	30013	54830	25721	46252

Table 17. NAFO Division 4T Catch at age ('000) including discards for 1976 to 1989.

AGE	YEAR 1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	47	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	69	0	68	0	0	124
4	1521	325	226	100	179	166	32	172	263	462	716	160	138	410
5	14340	4544	1560	722	951	384	738	1150	805	1752	1395	1587	953	2489
6	29725	12793	4422	3456	2795	2704	1325	3412	1916	2238	3504	6107	4232	5099
7	21182	20098	10132	8096	8039	6051	3265	3915	3652	3296	5391	9454	4188	11001
8	12006	11502	9660	11884	10701	7966	7132	7506	4228	4512	4635	9200	6310	9392
9	10404	5279	4382	8864	7596	7780	6803	11098	5585	3905	4576	8282	4763	8397
10	7420	3265	3591	5020	4582	6489	5969	8601	7575	4297	3061	7164	2601	5990
11	4560	2086	2532	2817	2748	3355	2940	10249	4354	5414	3839	6194	2274	3393
12	3771	2091	1529	1692	2879	2414	1691	5948	3999	5033	5380	5486	2204	3010
13	1466	1005	1410	1096	2397	1047	1035	2513	2019	3980	3825	3228	1811	2148
14	992	594	720	1000	1690	1389	735	1151	1522	3306	2656	2737	1939	1509
15	446	312	542	310	1586	2197	427	693	922	1727	1672	1869	1156	940
16	407	239	144	209	713	949	324	468	459	1117	1135	1173	836	572
17	364	201	102	127	462	1286	34	483	571	670	597	806	473	351
18	207	237	109	28	97	803	255	297	378	367	202	337	371	204
19	267	157	66	57	106	203	43	338	267	336	205	315	232	86
20	165	171	33	44	133	280	24	115	197	157	136	295	205	88
21	98	44	95	71	39	221	73	74	57	70	119	164	81	56
22	75	20	0	17	0	0	35	105	24	60	34	118	73	31
23	26	10	113	7	0	0	27	17	18	28	25	87	47	18
24	14	17	29	32	0	0	11	3	0	15	18	45	50	6
25	11	0	0	14	0	0	6	16	0	20	6	24	24	6
26	6	14	15	0	0	0	2	11	0	0	6	26	0	3
TOTAL	109473	65004	41412	45663	47693	45684	32926	58382	38880	42762	43201	64858	34961	55323

Table 17b. Weights at age of commercial catch at age for American plaice in NAFO Division 4T.

AGE	YEAR													
	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
1	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2	.	.	.	.	.	.	.	0.355	.	.	.	.	.	.
3	.	.	.	.	.	.	.	.	0.182	0.110	0.248	.	.	0.218
4	0.110	0.116	0.138	0.171	0.189	0.182	0.144	0.128	0.152	0.201	0.209	0.146	0.167	0.190
5	0.147	0.138	0.145	0.123	0.180	0.196	0.186	0.169	0.170	0.205	0.209	0.156	0.200	0.211
6	0.188	0.175	0.158	0.137	0.192	0.207	0.202	0.178	0.201	0.207	0.219	0.188	0.217	0.225
7	0.231	0.211	0.175	0.150	0.203	0.217	0.223	0.177	0.224	0.243	0.241	0.210	0.250	0.241
8	0.278	0.258	0.207	0.179	0.238	0.252	0.238	0.203	0.236	0.249	0.253	0.251	0.282	0.261
9	0.310	0.286	0.240	0.200	0.275	0.282	0.275	0.227	0.263	0.245	0.258	0.256	0.284	0.292
10	0.330	0.317	0.262	0.219	0.302	0.323	0.306	0.236	0.284	0.255	0.297	0.285	0.281	0.299
11	0.372	0.348	0.290	0.247	0.370	0.341	0.331	0.264	0.320	0.261	0.302	0.316	0.307	0.312
12	0.387	0.379	0.346	0.285	0.431	0.443	0.430	0.275	0.330	0.274	0.301	0.333	0.334	0.312
13	0.722	0.474	0.335	0.410	0.453	0.447	0.533	0.348	0.370	0.291	0.305	0.393	0.369	0.309
14	0.349	1.054	0.759	0.437	0.300	0.494	0.916	0.298	0.335	0.294	0.313	0.359	0.362	0.325
15	0.449	0.456	0.931	0.619	0.832	0.273	0.436	0.307	0.430	0.249	0.353	0.360	0.433	0.346
16	1.222	0.437	0.945	1.248	0.875	1.034	1.076	1.112	1.227	0.282	0.382	0.436	0.621	0.347
17	0.468	1.954	0.882	1.605	1.046	1.101	1.240	0.467	0.577	0.251	0.358	0.321	0.531	0.396
18	1.531	2.054	1.267	1.948	1.380	1.211	1.326	1.352	1.565	0.240	0.154	1.318	0.478	0.530
19	1.543	2.163	1.988	2.057	1.250	1.346	1.526	1.380	1.632	0.362	0.227	1.332	1.367	1.585
20	1.678	2.276	1.474	1.713	0.773	1.607	1.664	1.491	1.699	0.468	1.335	1.607	1.755	1.490
21	1.862	2.731	1.664	1.906	2.096	1.822	1.648	1.757	1.871	1.898	1.562	1.607	1.755	1.617
22	2.121	2.975	.	2.289	1.343	1.495	1.913	1.634	2.424	2.036	0.408	1.834	1.895	1.798
23	2.121	1.384	1.873	1.916	1.169	1.562	0.858	1.914	2.581	1.821	1.964	1.845	1.746	1.717
24	2.440	1.678	1.718	0.149	.	2.041	1.813	1.235	.	2.188	2.174	1.874	1.928	2.183
25	0.354	.	.	2.124	.	1.789	2.100	2.032	.	2.471	1.728	1.928	1.896	2.273
26	2.251	1.897	2.849	.	.	2.161	2.748	1.820	.	.	2.387	1.907	.	2.449

Table 18. 4T American plaice R.V. mean catch per tow adjusted (Prince*1.8)

AGE	1971	1972	1973	1974	1975	1976	1977	1978
1	1.24	1.04	0.88	0.82	0.48	0.00	0.71	0.00
2	8.41	8.16	7.14	16.56	4.58	5.23	5.63	1.30
3	26.07	14.66	23.35	57.59	22.79	52.49	80.11	10.26
4	43.52	33.63	32.56	116.32	85.16	175.19	228.75	83.33
5	41.88	32.68	37.79	97.87	159.00	257.07	312.34	110.19
6	43.55	36.62	29.36	80.00	81.14	202.69	183.02	122.79
7	45.03	42.02	24.69	52.60	62.77	96.91	121.98	113.10
8	27.44	28.91	27.33	40.63	39.77	42.43	53.74	74.98
9	9.50	13.15	21.39	45.37	28.44	38.05	21.81	24.63
10	6.65	7.74	9.52	27.72	19.16	26.51	14.65	15.92
11	5.89	3.67	5.05	12.39	14.70	17.88	8.67	8.39
12	3.79	3.53	3.87	4.04	4.31	11.82	5.93	4.27
13	2.78	1.83	3.16	3.37	2.40	7.03	3.68	4.67
14	2.36	1.17	3.58	3.42	1.85	3.65	2.13	1.53
15	1.45	0.51	1.94	2.44	1.11	1.58	1.19	1.41
16	1.22	0.64	1.48	1.24	1.07	1.37	0.32	0.55
17	1.07	0.16	1.34	0.60	0.15	1.44	0.44	0.32
18	0.47	0.16	0.59	0.54	1.09	0.55	0.13	0.14
19	0.12	0.06	1.65	0.17	0.58	0.04	0.60	0.14
20+	0.36	0.06	1.68	0.35	0.92	0.66	0.12	0.28
1+	272.80	230.40	238.35	564.04	531.47	942.59	1045.95	578.20

AGE	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
1	0.08	2.64	2.76	1.69	2.94	0.22	1.36	3.76	0.49	0.79	0.75
2	1.37	7.13	14.65	13.81	11.96	2.78	6.66	3.72	5.54	4.16	4.34
3	6.81	35.17	29.90	14.49	29.46	5.13	17.39	13.24	12.88	16.39	12.15
4	66.07	80.13	72.80	18.18	35.37	23.95	22.11	32.01	24.31	28.29	26.98
5	181.36	90.62	97.81	34.73	43.37	32.29	41.75	28.52	36.39	34.54	37.40
6	163.86	113.05	115.73	30.03	42.15	30.48	37.40	43.28	31.70	53.86	28.32
7	184.15	79.65	125.42	44.95	31.36	27.54	27.01	26.82	32.47	34.18	31.17
8	138.53	64.02	72.78	61.72	50.35	25.84	20.37	15.55	19.41	32.50	20.53
9	63.76	33.11	49.09	32.29	47.79	23.77	17.54	10.52	16.63	19.72	12.86
10	32.86	17.42	25.68	21.50	27.65	28.18	13.12	6.66	10.35	9.65	8.83
11	18.31	10.55	11.67	9.06	27.48	10.46	17.89	8.90	7.82	6.99	4.53
12	9.89	5.84	5.65	3.98	14.04	8.97	18.47	13.98	7.30	5.81	4.23
13	6.05	4.10	3.25	2.05	5.85	4.23	15.31	9.54	2.52	5.39	3.13
14	5.57	2.15	2.04	2.21	2.86	1.60	7.78	11.04	2.97	4.51	2.25
15	2.94	0.90	1.47	1.24	2.28	1.61	3.19	3.82	1.22	2.39	1.37
16	2.14	0.46	1.29	1.25	1.23	0.65	2.99	2.34	0.68	1.02	0.77
17	0.53	0.36	0.42	0.96	1.22	0.55	2.08	2.45	0.60	1.25	0.63
18	0.69	0.11	0.17	0.39	0.90	0.53	1.60	2.61	0.43	0.36	0.22
19	0.38	0.14	0.36	0.51	0.33	0.41	0.73	0.60	0.41	0.34	0.21
20+	1.01	0.18	0.38	0.44	0.58	0.61	2.42	2.34	0.55	0.68	0.32
1+	886.36	547.73	633.32	295.48	379.17	229.80	277.17	241.70	214.64	262.81	200.99

Table 19. Z at age (age by age) for 4T American plaice from RV results. Age and year are for first age and year.

AGE	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
1	-1.880	-1.928	-2.932	-1.721	-2.379	.000	-.604	.000	-4.479	-1.712	-1.611	-1.960	.056	-3.427	-1.005	-.438	-2.139	-1.704
2	-.556	-1.052	-2.088	-.319	-2.438	-2.729	-.601	-1.658	-3.246	-1.434	.011	-.757	.846	-1.833	-.687	-1.148	-1.085	-1.072
3	-.255	-.798	-1.606	-.391	-2.040	-1.472	-.039	-1.862	-2.465	-.727	.497	-.893	.207	-1.460	-.610	-.566	-.787	-.498
4	.286	-.116	-1.100	-.313	-1.105	-.578	.730	-.778	-.316	-.199	.740	-.869	.091	-.556	-.253	.057	-.351	-.279
5	.134	.107	-.750	.187	-.243	.340	.934	-.397	.473	-.245	1.181	-.193	.353	-.147	-.036	-.098	-.392	.199
6	.036	.394	.583	.243	-.178	.508	.481	-.405	.721	-.104	.946	-.043	.425	.121	.332	.270	-.025	.547
7	.443	.430	.498	.280	.391	.589	.487	-.203	1.057	.090	.709	-.113	.194	.302	.552	.543	-.001	.510
8	.736	.302	-.507	.357	.044	.665	.780	.162	1.431	.266	.813	.256	.751	.388	.661	.253	-.015	.927
9	.205	.323	-.259	.862	.070	.954	.315	-.288	1.298	.254	.826	.155	.528	.594	.969	.098	.544	.803
10	.595	.427	-.264	.634	.069	1.118	.557	-.140	1.136	.401	1.042	-.245	.972	.454	.388	-.019	.393	.756
11	.513	-.054	.223	1.057	.218	1.104	.708	-.165	1.143	.624	1.077	-.438	1.120	-.568	.246	.410	.297	.502
12	.725	.108	.139	.520	-.491	1.167	.239	-.347	.881	.585	1.012	-.386	1.200	-.535	.661	1.760	.303	.619
13	.864	-.670	-.076	.597	-.421	1.194	.879	-.177	1.036	.697	.389	-.332	1.295	-.610	.327	1.212	-.582	.874
14	1.525	-.503	.385	1.127	.157	1.123	.411	-.657	1.821	.377	.502	-.035	.576	-.691	.712	2.312	.217	1.191
15	.812	-1.057	.445	.821	-.217	1.588	.778	-.416	1.867	-.362	.167	.003	1.263	-.620	.310	1.590	.179	1.133
16	2.037	-.736	.896	2.132	-.292	1.129	.002	.038	1.781	.090	.298	.018	.816	-1.170	.198	1.495	-.609	.482
17	1.871	-1.309	.921	-.588	-1.311	2.404	1.188	-.752	1.547	.754	.069	.064	.845	-1.078	-.226	2.190	.511	1.737
18	2.142	-2.305	1.229	-.072	3.217	-.086	-.084	-1.026	1.573	-1.160	-1.104	.164	.797	-.327	.983	2.583	.235	.539
19	.761	-3.420	1.539	-1.672	-.136	-.999	.758	-1.971	.769	-.970	-.200	-.126	-.615	-1.783	-1.165	.366	-.506	.061

Table 20. Average Z from RV for 4T American plaice.

	Mortality		
AGE	1972-89	1972-79	1980-89
1	-1.659	-1.431	-1.842
2	-1.214	-1.430	-1.041
3	-0.876	-1.058	-0.730
4	-0.273	-0.372	-0.194
5	0.078	0.039	0.110
6	0.270	0.208	0.319
7	0.375	0.364	0.384
8	0.459	0.317	0.573
9	0.458	0.273	0.607
10	0.460	0.375	0.528
11	0.445	0.451	0.441
12	0.453	0.258	0.610
13	0.361	0.274	0.431
14	0.586	0.446	0.698
15	0.460	0.344	0.553
16	0.478	0.651	0.340
17	0.491	0.303	0.641
18	0.405	0.377	0.428
19	-0.517	-0.643	-0.417

Table 21. Standard error of catch at age for RV survey 1971-1989

AGE	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
1	0.32	0.32	0.32	0.32	0.01	-	0.14	-	0.01	0.71
2	1.82	1.84	1.41	3.89	0.95	1.82	0.84	0.32	0.01	0.84
3	5.27	2.90	3.55	10.74	2.79	13.51	14.01	2.10	0.71	2.76
4	9.71	5.58	3.44	13.79	8.99	38.09	41.34	17.99	7.60	5.99
5	8.45	6.06	4.21	6.69	15.40	36.57	53.13	23.31	18.27	7.49
6	7.95	6.09	3.27	5.17	8.00	16.41	27.01	26.65	13.66	10.04
7	7.18	6.31	2.63	3.66	6.39	7.17	14.70	25.17	13.30	7.71
8	3.79	4.32	2.66	3.69	3.92	3.22	5.40	15.60	10.02	6.96
9	1.18	2.02	1.84	4.73	2.79	3.16	2.00	4.24	5.10	3.71
10	1.00	1.00	1.00	3.32	1.73	2.32	1.41	2.41	2.65	2.00
11	0.85	0.01	0.93	1.41	1.41	1.41	0.88	1.00	1.73	1.00
12	0.80	0.02	0.91	0.01	0.61	1.00	0.09	0.33	1.00	0.10
13	0.56	0.03	0.91	0.81	0.96	1.00	0.98	0.21	1.00	0.45
14	0.64	0.01	0.90	0.71	0.03	0.01	0.94	0.14	1.00	0.08
15	0.51	0.02	0.80	0.77	0.23	0.01	0.57	0.08	0.97	0.08
16	0.51	0.25	0.54	0.65	0.18	0.01	0.69	0.07	0.34	0.08
17	0.47	0.23	0.17	0.89	0.17	0.01	0.43	0.04	0.49	0.24
18	0.48	0.18	0.01	0.17	0.13	0.01	0.20	0.01	0.33	0.09
19	0.24	0.20	1.00	0.06	0.81	0.01	0.17	0.01	0.21	0.19
20	0.17	0.11	0.02	0.05	0.09	0.01	0.04	0.01	0.14	0.03
21	-	0.01	0.01	0.09	0.02	0.01	0.04	0.01	0.01	0.01

AGE	1981	1982	1983	1984	1985	1986	1987	1988	1989
1	0.63	0.63	0.71	0.01	0.45	0.01	0.01	0.01	0.21
2	2.98	3.32	2.24	0.45	1.70	0.55	0.89	0.01	0.73
3	6.26	2.26	4.70	0.45	2.37	3.65	4.95	0.89	1.14
4	15.15	2.90	3.70	1.87	4.67	9.17	6.87	2.92	2.53
5	16.18	5.16	3.73	3.58	5.63	9.11	9.86	4.80	3.52
6	15.60	4.42	3.29	3.16	5.21	12.46	8.46	8.58	2.59
7	15.30	6.63	2.39	2.24	3.85	8.55	8.08	5.43	2.95
8	8.65	9.15	3.81	2.02	3.99	3.79	4.69	4.65	1.99
9	6.27	4.84	3.74	1.73	1.77	3.55	3.83	2.68	1.23
10	3.61	3.32	2.45	2.65	1.00	1.73	2.45	1.41	0.97
11	1.73	1.41	2.65	1.00	0.18	2.83	2.00	1.00	0.50
12	1.00	0.91	1.73	1.00	0.18	3.61	1.73	0.99	0.49
13	1.00	0.41	1.00	0.01	0.17	2.65	0.01	0.67	0.33
14	0.01	0.22	0.84	0.01	0.21	3.00	1.00	0.67	0.21
15	0.50	0.45	0.18	0.01	0.11	1.00	0.33	0.45	0.14
16	0.49	0.01	0.50	0.01	0.07	1.00	0.21	0.50	0.08
17	0.33	0.26	0.49	0.01	0.05	1.00	0.14	0.70	0.07
18	0.21	0.05	0.33	0.01	0.02	1.00	0.08	0.12	0.04
19	0.01	0.06	0.21	0.01	0.02	0.01	0.07	0.21	0.04
20	0.01	0.01	0.01	0.01	0.02	0.01	0.04	0.07	0.04
21	-	0.03	0.01	0.01	0.02	0.01	0.01	0.07	0.02

Table 22. COEFFICIENTS OF VARIATION (/100) FROM RV SURVEY.

AGE	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
0	.	.	.	.	.	.	.	0.5714	0.2123	0.1927				
1	.	0.3934	.	.	0.3510	0.6949	0.8099	0.4008	0.6407	0.3715	0.3310	0.4905	0.3691	.
2	0.3680	0.2220	0.5896	0.2576	0.1543	0.3127	0.4364	0.1993	0.2439	0.2175	0.2151	0.2385	0.2424	0.2741
3	0.2127	0.2330	0.3525	0.1558	0.1073	0.3060	0.2144	0.1844	0.1705	0.1704	0.2954	0.3631	0.2147	0.1679
4	0.2117	0.2467	0.3639	0.1563	0.1022	0.2944	0.2101	0.1394	0.2108	0.1892	0.3010	0.2103	0.174	0.3058
5	0.1831	0.2846	0.3481	0.1340	0.1129	0.2204	0.1939	0.1199	0.2184	0.2439	0.3057	0.1808	0.1563	0.0939
6	0.1091	0.1944	0.3435	0.1139	0.1217	0.1776	0.2038	0.1073	0.1962	0.2288	0.3024	0.196	0.1567	0.0942
7	0.0958	0.1518	0.3556	0.0981	0.1284	0.1634	0.2060	0.1048	0.1672	0.229	0.2816	0.1947	0.1605	0.0917
8	0.1020	0.1388	0.2754	0.0957	0.1447	0.1607	0.1972	0.1025	0.1611	0.2032	0.2644	0.192	0.1672	0.0945
9	0.1306	0.1453	0.2417	0.1038	0.1548	0.1712	0.1979	0.1098	0.1381	0.1982	0.2485	0.1879	0.1486	0.0967
10	0.1462	0.1339	0.2192	0.1109	0.1524	0.1907	0.2222	0.1227	0.1494	0.1933	0.2306	0.1967	0.1379	0.3080
11	0.1047	0.1167	0.1611	0.1034	0.1269	0.1852	0.1763	0.1506	0.1622	0.1930	0.2796	0.1997	0.1263	0.0156
12	0.1161	0.1474	0.2129	0.1397	0.1620	0.2738	0.2594	0.2208	0.1772	0.1832	0.2407	0.2240	0.1155	0.1104
13	0.1716	0.1542	0.2296	0.2118	0.1752	0.3380	0.2749	0.3438	0.1751	0.1899	0.2864	0.2246	0.1374	0.1159
14	0.1911	0.1899	0.3690	0.2231	0.1803	0.3064	0.3384	0.3757	0.1714	0.1477	0.2700	0.2522	0.1436	0.1048
15	0.2380	0.2211	0.2219	0.2734	0.2291	0.2435	0.3088	0.3580	0.2410	0.1502	0.2223	0.2007	0.1825	0.0927
16	0.3250	0.3011	0.3822	0.2510	0.2291	0.2602	0.3395	0.3390	0.3183	0.1265	0.3990	0.2552	0.2184	0.0986
17	0.2915	0.4239	0.4459	0.5382	0.2900	0.2630	0.3604	0.2929	0.2773	0.1295	0.5469	0.2880	0.3123	0.1043
18	0.3898	0.4061	0.3596	0.1867	0.0233	0.0264	0.0428	0.0727	0.3433	0.1211	0.4625	0.5711	0	0.1112
19	1.0000	0.4738	0.3300	0.3760	0.4075	0.3431	0.3555	0.3878	0.3934	0	0.3709			0.2026
20	0.0335	0.0221	0.0286	0.2383	0.0210	0.0234	0.0246	0.0229	0.6031	0.2018	0.5327			0.1905
21	0.2945	.	.	0.5476	0.7075	.	1.0000	0.3592	0	0.6011	0	0		0.2937
22	1.0000	.	0.5856	0.4663	1.0000	0.4514	0.4541	0.8505	0	0	0			0.2208
23	.	0.6446	.	.	.	.	0.6346	.	0	0	0.6812			0.2208
24	1.0000	.	.	0.1500	.	0.7086	.	0.5335	0	0	0			0.2464
25	.	.	.	.	.	.	1.0000	.			0			0.7221
26	.	.	.	.	.	.	0.5210	0.0200		0	0			0.3294

Table 23. RV mean numbers per tow for ages 1+ to 20+ from 1971 to 1989 .

AGE	YEAR 1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
1+	272.80	230.40	238.35	564.04	531.47	942.59	1045.95	578.20	886.36	547.73
2+	271.56	229.36	237.47	563.22	530.99	942.59	1045.24	578.20	886.28	545.09
3+	263.15	221.20	230.33	546.66	526.41	937.36	1039.61	576.90	884.91	537.96
4+	237.08	206.54	206.98	489.07	503.62	884.87	959.50	566.64	878.10	502.79
5+	193.56	172.91	174.42	372.75	418.46	709.68	730.75	483.31	812.03	422.66
6+	151.68	140.23	136.63	274.88	259.46	452.61	418.41	373.12	630.67	332.04
7+	108.13	103.61	107.27	194.88	178.32	249.92	235.39	250.33	466.81	218.99
8+	63.10	61.59	82.58	142.28	115.55	153.01	113.41	137.23	282.66	139.34
9+	35.66	32.68	55.25	101.65	75.78	110.58	59.67	62.25	144.13	75.32
10+	26.16	19.53	33.86	56.28	47.34	72.53	37.86	37.62	80.37	42.21
11+	19.51	11.79	24.34	28.56	28.18	46.02	23.21	21.70	47.51	24.79
12+	13.62	8.12	19.29	16.17	13.48	28.14	14.54	13.31	29.20	14.24
13+	9.83	4.59	15.42	12.13	9.17	16.32	8.61	9.04	19.31	8.40
14+	7.05	2.76	12.26	8.76	6.77	9.29	4.93	4.37	13.26	4.30
15+	4.69	1.59	8.68	5.34	4.92	5.64	2.80	2.84	7.69	2.15
16+	3.24	1.08	6.74	2.90	3.81	4.06	1.61	1.43	4.75	1.25
17+	2.02	0.44	5.26	1.66	2.74	2.69	1.29	0.88	2.61	0.79
18+	0.95	0.28	3.92	1.06	2.59	1.25	0.85	0.56	2.08	0.43
19+	0.48	0.12	3.33	0.52	1.50	0.70	0.72	0.42	1.39	0.32
20+	0.36	0.06	1.68	0.35	0.92	0.66	0.12	0.28	1.01	0.18

AGE	YEAR 1981	1982	1983	1984	1985	1986	1987	1988	1989
1+	633.32	295.48	379.17	229.80	277.17	241.70	214.67	262.82	200.99
2+	630.56	293.79	376.23	229.58	275.81	237.94	214.18	262.03	200.24
3+	615.91	279.98	364.27	226.80	269.15	234.22	208.64	257.87	195.90
4+	586.01	265.49	334.81	221.67	251.76	220.98	195.76	241.48	183.75
5+	513.21	247.31	299.44	197.72	229.65	188.97	171.45	213.19	156.77
6+	415.40	212.58	256.07	165.43	187.90	160.45	135.06	178.65	119.37
7+	299.67	182.55	213.92	134.95	150.50	117.17	103.36	124.79	91.05
8+	174.25	137.60	182.56	107.41	123.49	90.35	70.89	90.61	59.88
9+	101.47	75.88	132.21	81.57	103.12	74.80	51.48	58.11	39.35
10+	52.38	43.59	84.42	57.80	85.58	64.28	34.85	38.39	26.49
11+	26.70	22.09	56.77	29.62	72.46	57.62	24.50	28.74	17.66
12+	15.03	13.03	29.29	19.16	54.57	48.72	16.68	21.75	13.13
13+	9.38	9.05	15.25	10.19	36.10	34.74	9.38	15.94	8.90
14+	6.13	7.00	9.40	5.96	20.79	25.20	6.86	10.55	5.77
15+	4.09	4.79	6.54	4.36	13.01	14.16	3.89	6.04	3.52
16+	2.62	3.55	4.26	2.75	9.82	10.34	2.67	3.65	2.15
17+	1.33	2.30	3.03	2.10	6.83	8.00	1.99	2.63	1.38
18+	0.91	1.34	1.81	1.55	4.75	5.55	1.39	1.38	0.75
19+	0.74	0.95	0.91	1.02	3.15	2.94	0.96	1.02	0.53
20+	0.38	0.44	0.58	0.61	2.42	2.34	0.55	0.68	0.32

Table 24. TOTAL Z AMER PLAICE (4T) FROM RV

GROUP	YEAR 1971	1972	1973	1974	1975	1976	1977	1978
1+	0.17345	-0.0302	-0.85993	0.06038	-0.57298	-0.10337	0.592761	-0.42711
2+	0.20512	-0.0042	-0.83379	0.06759	-0.56832	-0.09797	0.594333	-0.42557
3+	0.24223	0.0664	-0.75299	0.08201	-0.51936	-0.02334	0.606877	-0.42009
4+	0.31563	0.1690	-0.58829	0.15592	-0.34299	0.19137	0.685754	-0.35981
5+	0.32230	0.2355	-0.45487	0.36231	-0.07845	0.52835	0.672171	-0.26612
6+	0.38114	0.2679	-0.35511	0.43275	0.03746	0.65379	0.513682	-0.22402
7+	0.56283	0.2269	-0.28245	0.52268	0.15308	0.79013	0.539585	-0.12146
8+	0.65796	0.1086	-0.20777	0.62996	0.04396	0.94167	0.599851	-0.04906
9+	0.60208	-0.0355	-0.01847	0.76418	0.04383	1.07184	0.461294	-0.25548
10+	0.79698	-0.2202	0.17023	0.69173	0.02828	1.13942	0.556583	-0.23340
11+	0.87660	-0.4923	0.40896	0.75080	0.00142	1.15217	0.556068	-0.29686
12+	1.08766	-0.6413	0.46391	0.56722	-0.19118	1.18427	0.475244	-0.37211
13+	1.27021	-0.9825	0.56547	0.58318	-0.01300	1.19705	0.678161	-0.38309
14+	1.48929	-1.1458	0.83112	0.57689	0.18262	1.19932	0.551535	-0.56516
15+	1.46847	-1.4443	1.09631	0.33760	0.19213	1.25365	0.671945	-0.51434
16+	1.99655	-1.5832	1.40124	0.05675	0.34809	1.14654	0.604068	-0.60168
17+	1.97606	-2.1871	1.60186	-0.44484	0.78481	1.15206	0.834461	-0.86020
18+	2.06897	-2.4759	2.02002	-0.34720	1.30833	0.55165	0.704982	-0.90912
19+	2.07944	-2.6391	2.25279	-0.57054	0.82098	1.76359	0.944462	-0.87745

GROUP	Year 1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
1+	0.48617	-0.14083	0.768111	-0.24160	0.50173	-0.18250	0.152612	0.12088	-0.19936	0.2719
2+	0.49925	-0.12215	0.811890	-0.21503	0.50613	-0.15902	0.163451	0.13141	-0.18564	0.2908
3+	0.56531	-0.08555	0.841524	-0.17885	0.49671	-0.10441	0.197197	0.17937	-0.14618	0.3388
4+	0.73119	-0.02051	0.862694	-0.12034	0.52671	-0.03537	0.286888	0.25378	-0.08529	0.4320
5+	0.89428	0.01733	0.881367	-0.03481	0.59337	0.05094	0.358574	0.33587	-0.04114	0.5799
6+	1.05776	0.10257	0.822218	-0.00628	0.64055	0.09459	0.472284	0.43976	0.07909	0.6740
7+	1.20901	0.22854	0.778331	-0.00005	0.68895	0.08874	0.510272	0.50250	0.13165	0.7342
8+	1.32250	0.31715	0.831338	0.03996	0.80562	0.04076	0.501342	0.56250	0.19879	0.8340
9+	1.22806	0.36322	0.844935	-0.10665	0.82740	-0.04799	0.472645	0.76376	0.29340	0.7855
10+	1.17620	0.45799	0.863400	-0.26418	1.04735	-0.22605	0.395582	0.96458	0.19276	0.7764
11+	1.20489	0.50039	0.717409	-0.28212	1.08618	-0.61103	0.396945	1.23966	0.11906	0.7833
12+	1.24594	0.41748	0.507283	-0.15733	1.05584	-0.63347	0.451593	1.64751	0.04538	0.8935
13+	1.50201	0.31504	0.292670	-0.03794	0.93951	-0.71307	0.359449	1.62218	-0.11755	1.0161
14+	1.81928	0.05007	0.246664	0.06797	0.76824	-0.78065	0.384051	1.86843	0.12730	1.0976
15+	1.81678	-0.19771	0.141597	0.11726	0.86634	-0.81195	0.229698	1.66834	0.06368	1.0329
16+	1.79387	-0.06204	0.130265	0.15838	0.70733	-0.90972	0.204980	1.64789	0.01509	0.9726
17+	1.80332	-0.14141	-0.007491	0.23958	0.67031	-0.81621	0.207527	1.75014	0.36605	1.2546
18+	1.87180	-0.54286	-0.043017	0.38698	0.57352	-0.70915	0.479735	1.75462	0.30950	0.9569
19+	2.04410	-0.17185	0.519875	0.49343	0.39999	-0.86396	0.297252	1.67625	0.34484	1.1592

Table 25. Biomass (t): age 1 to 9 and fishable biomass (age 10+) for 1987-1989.

YEAR	Age 1 to 9 MALES	FEMALES	TOTAL	Age 10+ MALES	FEMALES	TOTAL
1987	26,893.6	24,089.0	50,982.6	6,197.6	18,884.5	25,082.1
1988	30,994.9	29,347.9	60,342.8	7,548.3	18,619.7	26,168.0
1989	18,949.0	21,869.1	40,818.1	5,728.7	16,760.2	22,488.9

Table 26. Yield per recruit analysis.

AGE	WEIGHT-AT-AGE	PARTIAL RECRUITMENT
4	.167	.006
5	.188	.036
6	.205	.115
7	.226	.263
8	.247	.446
9	.263	.608
10	.280	.785
11	.302	.854
12	.324	1.000
13	.365	1.000
14	.400	1.000
15	.364	1.000
16	.685	1.000
17	.518	1.000
18	.870	1.000
19	1.176	1.000
20	1.439	1.000

NATURAL MORTALITY RATE : 0.2
F0.1 COMPUTED AS .3183 AT Y/R OF .0750
FMAX COMPUTED AS 1.5000 AT Y/R OF .1054

WARNING: CONVERGENCE CRITERION NOT SATISFIED FOR FMAX.
FMAX IS THE VALUE OF F GIVING THE HIGHEST YIELD,
FOR ALL F COMPUTED IN THE GIVEN INTERVAL!

YIELD PER RECRUIT ANALYSIS

	FISHING MORTALITY	CATCH (NUMBER)	YIELD (KG)	AVG. WEIGHT (KG)	YIELD PER UNIT EFFORT
	.1000	.136	.045	.330	1.909
	.2000	.214	.064	.298	1.353
	.3000	.264	.074	.279	1.042
F0.1---	.3183	.271	.075	.276	1.000
	.4000	.300	.080	.267	.849
	.5000	.328	.085	.259	.719
	.6000	.350	.088	.253	.626
	.7000	.369	.092	.248	.555
	.8000	.385	.094	.245	.499
	.9000	.399	.096	.242	.454
	1.0000	.411	.098	.239	.417
	1.1000	.422	.100	.237	.386
	1.2000	.432	.102	.235	.359
	1.3000	.441	.103	.234	.336
	1.4000	.449	.104	.232	.316
	1.5000	.457	.105	.231	.298
FMAX---	1.5000	.457	.105	.231	.298

Table 27. ESTIMATED PARAMETERS AND STANDARD ERRORS
APPROXIMATE STATISTICS ASSUMING LINEARITY NEAR SOLUTION

ORTHOGONALITY OFFSET..... 0.014677
MEAN SQUARE RESIDUALS 16.218297

PAR. EST.	STD. ERR.	T-STATISTIC
8.39217E0004	3.37732E0004	2.48486E0000
6.63193E0004	2.27160E0004	2.91949E0000
4.58806E0004	1.33977E0004	3.42451E0000
5.10093E0004	1.38391E0004	3.68569E0000
3.18587E0004	8.33845E0003	3.82070E0000
2.09070E0004	5.43119E0003	3.84944E0000
1.50002E0004	4.27271E0003	3.51069E0000
7.84357E0003	2.53215E0003	3.09759E0000
6.84073E0003	2.31968E0003	2.94907E0000
5.11834E0003	1.77223E0003	2.88808E0000
6.39826E0003	1.77822E0003	3.59812E0000
3.76411E-004	5.48484E-005	6.86275E0000
6.92338E-004	8.88300E-005	7.79396E0000
8.12456E-004	9.80759E-005	8.28395E0000
8.29610E-004	9.38406E-005	8.84063E0000
9.07649E-004	9.76804E-005	9.29204E0000
7.72384E-004	8.61164E-005	8.96908E0000
6.51408E-004	7.55604E-005	8.62103E0000
5.52394E-004	6.76519E-005	8.16524E0000
5.05677E-004	6.40865E-005	7.89054E0000
4.20915E-004	6.26169E-005	6.72207E0000
3.43202E-004	5.64000E-005	6.08514E0000

WEIGHTED RESIDUALS FOR RV INDEX

I	1976	1977	1978	1979	1980	1981	1982	1983	1984
4	5.255	4.979	.884	1.979	9.698	3.254	-5.510	.904	-4.338
5	5.131	9.145	.194	6.122	1.459	3.629	-5.118	.257	-4.744
6	7.947	3.709	.305	6.242	2.166	3.245	-6.522	-2.559	-2.912
7	6.777	4.915	1.252	9.018	.297	4.232	-3.276	-5.468	-4.599
8	-.868	2.002	1.776	9.642	-1.809	1.458	-.168	.022	-3.870
9	3.153	-2.526	-.833	8.487	-2.280	.828	-1.885	3.738	-4.082
10	4.051	-2.240	-.017	8.057	-1.018	.840	-2.193	2.916	2.977
11	6.454	-2.801	-2.346	3.345	1.230	.256	-5.175	5.286	-2.250
12	5.173	-1.090	-5.686	3.735	-.022	-.387	-6.041	3.197	.642
13	5.855	-3.457	1.478	2.247	.495	-.326	-5.101	1.444	-.762
14	7.355	1.403	-4.513	5.339	-1.494	-.209	.378	1.374	-4.056

I	1985	1986	1987	1988	1989
4	-1.567	-.102	.350	.426	-.020
5	-1.000	-1.651	-1.875	.207	-.225
6	-1.634	.006	-1.022	1.157	-.250
7	-1.010	-.932	.422	1.062	.562
8	-2.490	-2.244	-1.250	2.121	1.087
9	-1.758	-2.076	1.715	2.349	3.260
10	-5.464	-3.283	1.018	2.993	3.563
11	3.275	-.713	1.379	3.179	4.537
12	5.788	2.257	.949	4.311	4.992
13	7.875	2.331	-.098	3.259	6.006
14	7.373	3.066	2.212	5.348	3.586

SUM OF RV RESIDUALS : 158.428915 MEAN RESIDUAL : 1.028759183

Table 28. Parameter Correlation Matrix. Parameters 1 thru 11 represent the intercepts of regressions on ages 4 - 14. Parameters 12 thru 22 represent the slopes of the regressions on ages 4 - 14.

Parameter Correlation Matrix

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	1.000	.066	.058	.050	.043	.038	.035	.032	.040	.037	.035	-.288	-.043	-.034	-.029	-.026	-.025	-.024	-.023	-.023	-.021	-.020
2	.066	1.000	.079	.069	.059	.053	.048	.044	.055	.051	.048	-.229	-.229	-.047	-.040	-.036	-.034	-.033	-.031	-.031	-.029	-.028
3	.058	.079	1.000	.083	.072	.063	.058	.053	.066	.062	.057	-.200	-.196	-.206	-.048	-.044	-.041	-.039	-.038	-.037	-.035	-.034
4	.050	.069	.083	1.000	.083	.073	.066	.060	.076	.070	.065	-.175	-.172	-.174	-.205	-.050	-.047	-.044	-.043	-.043	-.040	-.039
5	.043	.059	.072	.083	1.000	.084	.074	.066	.085	.079	.074	-.150	-.147	-.153	-.163	-.216	-.053	-.050	-.048	-.048	-.045	-.044
6	.038	.053	.063	.073	.084	1.000	.086	.076	.095	.088	.083	-.133	-.131	-.130	-.141	-.163	-.225	-.057	-.054	-.054	-.051	-.049
7	.035	.048	.058	.066	.074	.086	1.000	.089	.109	.099	.094	-.123	-.121	-.119	-.122	-.140	-.165	-.231	-.062	-.061	-.057	-.055
8	.032	.044	.053	.060	.066	.076	.089	1.000	.125	.112	.106	-.112	-.110	-.109	-.111	-.119	-.146	-.173	-.235	-.070	-.065	-.063
9	.040	.055	.066	.076	.085	.095	.109	.125	1.000	.131	.143	-.138	-.137	-.138	-.144	-.157	-.173	-.206	-.238	-.296	-.167	-.203
10	.037	.051	.062	.070	.079	.088	.099	.112	.131	1.000	.159	-.129	-.129	-.128	-.132	-.147	-.162	-.177	-.210	-.247	-.308	-.190
11	.035	.048	.057	.065	.074	.083	.094	.106	.143	.159	1.000	-.120	-.120	-.119	-.123	-.137	-.157	-.174	-.192	-.231	-.271	-.330
12	-.288	-.229	-.200	-.175	-.150	-.133	-.123	-.112	-.138	-.129	-.120	1.000	.151	.118	.101	.092	.086	.082	.079	.078	.074	.071
13	-.043	-.229	-.196	-.172	-.147	-.131	-.121	-.110	-.137	-.129	-.120	.151	1.000	.117	.099	.090	.085	.081	.078	.078	.073	.071
14	-.034	-.047	-.206	-.174	-.153	-.130	-.119	-.109	-.138	-.128	-.119	.118	.117	1.000	.100	.091	.084	.081	.078	.078	.073	.070
15	-.029	-.040	-.048	-.205	-.163	-.141	-.122	-.111	-.144	-.132	-.123	.101	.099	.100	1.000	.096	.089	.083	.081	.081	.075	.073
16	-.026	-.036	-.044	-.050	-.216	-.163	-.140	-.119	-.157	-.147	-.137	.092	.090	.091	.096	1.000	.099	.093	.088	.089	.084	.081
17	-.025	-.034	-.041	-.047	-.053	-.225	-.165	-.146	-.173	-.162	-.157	.086	.085	.084	.089	.099	1.000	.106	.101	.099	.094	.091
18	-.024	-.033	-.039	-.044	-.050	-.057	-.231	-.173	-.206	-.177	-.174	.082	.081	.081	.083	.093	.106	1.000	.116	.113	.105	.103
19	-.023	-.031	-.038	-.043	-.048	-.054	-.062	-.235	-.238	-.210	-.192	.079	.078	.078	.081	.088	.101	.116	1.000	.130	.120	.117
20	-.023	-.031	-.037	-.043	-.048	-.054	-.061	-.070	-.296	-.247	-.231	.078	.078	.078	.081	.089	.099	.113	.130	1.000	.144	.141
21	-.021	-.029	-.035	-.040	-.045	-.051	-.057	-.065	-.167	-.308	-.271	.074	.073	.073	.075	.084	.094	.105	.120	.144	1.000	.141
22	-.020	-.028	-.034	-.039	-.044	-.049	-.055	-.063	-.203	-.190	-.330	.071	.071	.070	.073	.081	.091	.103	.117	.141	.141	1.000

Table 29. 4T PLAICE TUNING MAY 1990

POPULATION NUMBERS (000S)

	1976	1977	1978	1979	1980	1981	1982	1983	1984
4	260566	219290	210469	169740	114567	108939	83624	102004	99180
5	220978	211957	179245	172113	138881	93638	89042	72530	83358
6	177369	167946	169424	145342	140261	112846	76317	72233	58342
7	105979	118321	125927	134712	115869	112307	89943	61284	56052
8	67364	67602	78688	93932	102967	87591	86474	70685	46633
9	52035	44289	44940	55684	66152	74620	64506	64346	51080
10	37505	33189	31484	32829	37569	47288	54054	46657	42640
11	25336	23993	24218	22528	22336	26613	32844	38854	30417
12	21215	16617	17756	17537	15895	15801	18753	24231	22538
13	9818	13957	11713	13154	12827	10409	10752	13824	14456
14	3751	6712	10518	8314	9778	8333	7575	7867	9044
15	4944	2174	4958	7960	5902	6476	5566	5537	5399
16	2661	3644	1497	3568	6237	3397	3314	4171	3906
17	1793	1810	2767	1096	2733	4461	1923	2420	2991
18	982	1139	1300	2173	782	1819	2489	1543	1545
19	2284	617	718	966	1754	553	763	1807	995
20	974	1628	363	528	739	1340	269	586	1173
4+	995554	934885	915987	882176	795249	716430	633207	590578	529750

	1985	1986	1987	1988	1989
4	91220	102282	69646	80963	83774
5	80964	74266	83094	56877	66162
6	67519	64702	59542	66596	45704
7	46033	53255	49803	43223	50695
8	42587	34706	38724	32221	31598
9	34354	30785	24221	23380	20671
10	36768	24593	21064	12337	14832
11	28056	26215	17365	10763	7747
12	20964	18072	17989	8613	6755
13	14834	12610	9928	9764	5058
14	10009	8544	6863	5207	6356
15	6028	5203	4592	3142	2509
16	3586	3372	2747	2068	1527
17	2783	1925	1734	1188	937
18	1932	1672	1036	690	545
19	923	1250	1186	543	230
20	573	451	838	686	235
4+	489132	463905	410373	358263	345334

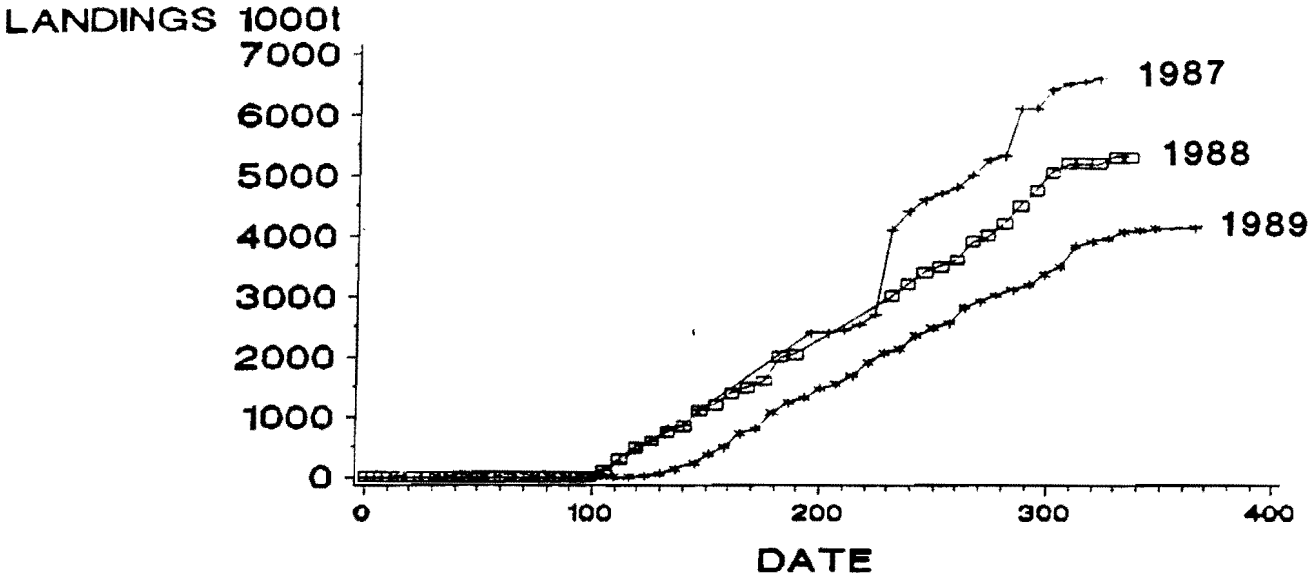
Table 30. 4T PLAICE TUNING MAY 1990

FISHING MORTALITY

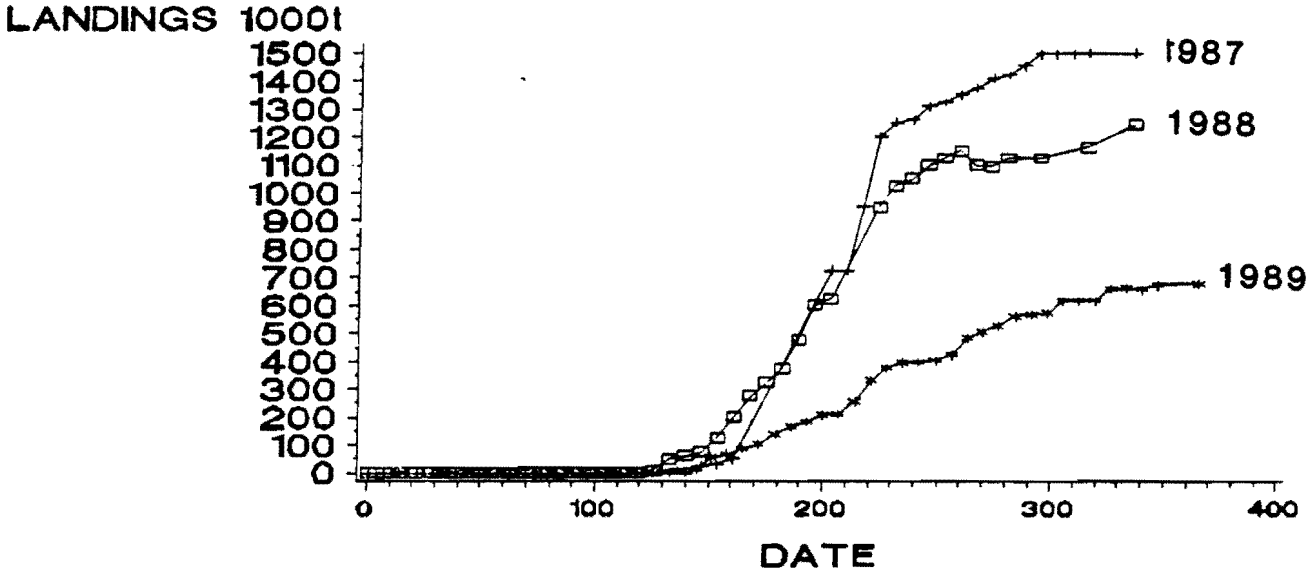
	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
4	.006	.002	.001	.001	.002	.002	.000	.002	.003	.006	.008	.003
5	.074	.024	.010	.005	.008	.005	.009	.018	.011	.024	.021	.021
6	.205	.088	.029	.027	.022	.027	.019	.054	.037	.037	.062	.120
7	.250	.208	.093	.069	.080	.061	.041	.073	.075	.082	.119	.235
8	.219	.208	.146	.151	.122	.106	.096	.125	.106	.125	.160	.305
9	.250	.141	.114	.193	.136	.122	.124	.211	.129	.134	.179	.475
10	.247	.115	.135	.185	.145	.164	.130	.228	.219	.138	.148	.471
11	.222	.101	.123	.149	.146	.150	.104	.345	.172	.240	.177	.501
12	.219	.150	.100	.113	.223	.185	.105	.316	.218	.308	.399	.411
13	.180	.083	.143	.097	.231	.118	.112	.224	.168	.352	.408	.445
14	.346	.103	.079	.143	.212	.204	.113	.176	.206	.454	.421	.581
15	.105	.173	.129	.044	.352	.470	.089	.149	.209	.381	.439	.598
16	.185	.075	.112	.067	.135	.369	.114	.132	.139	.422	.465	.638
17	.254	.131	.042	.137	.207	.384	.020	.249	.237	.309	.420	.721
18	.265	.261	.097	.014	.147	.669	.120	.239	.315	.236	.143	.445
19	.138	.330	.107	.067	.069	.521	.064	.232	.352	.515	.200	.347
20	.206	.123	.106	.096	.220	.261	.104	.243	.204	.357	.401	.487

	1988	1989
4	.002	.005
5	.019	.042
6	.073	.131
7	.113	.272
8	.244	.394
9	.255	.587
10	.265	.582
11	.266	.650
12	.332	.666
13	.229	.623
14	.530	.302
15	.522	.527
16	.592	.527
17	.580	.527
18	.901	.527
19	.638	.527
20	.397	.527

MOBILE GEAR



FIXED GEAR



TOTAL CATCH

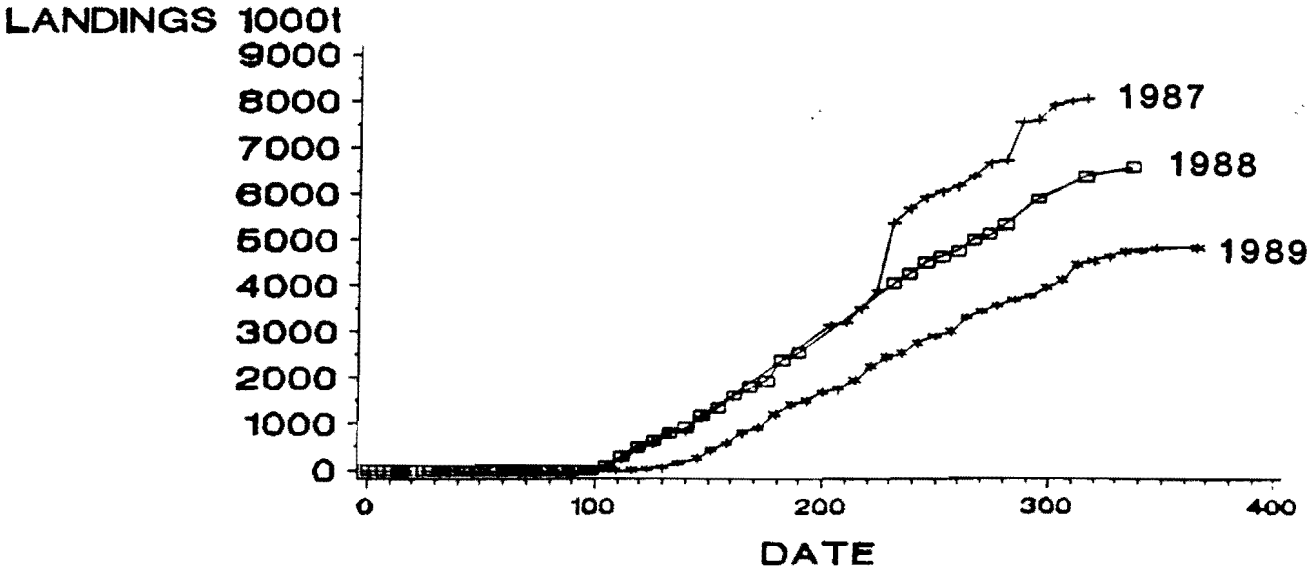


Figure 1 Weekly catches of American plaice

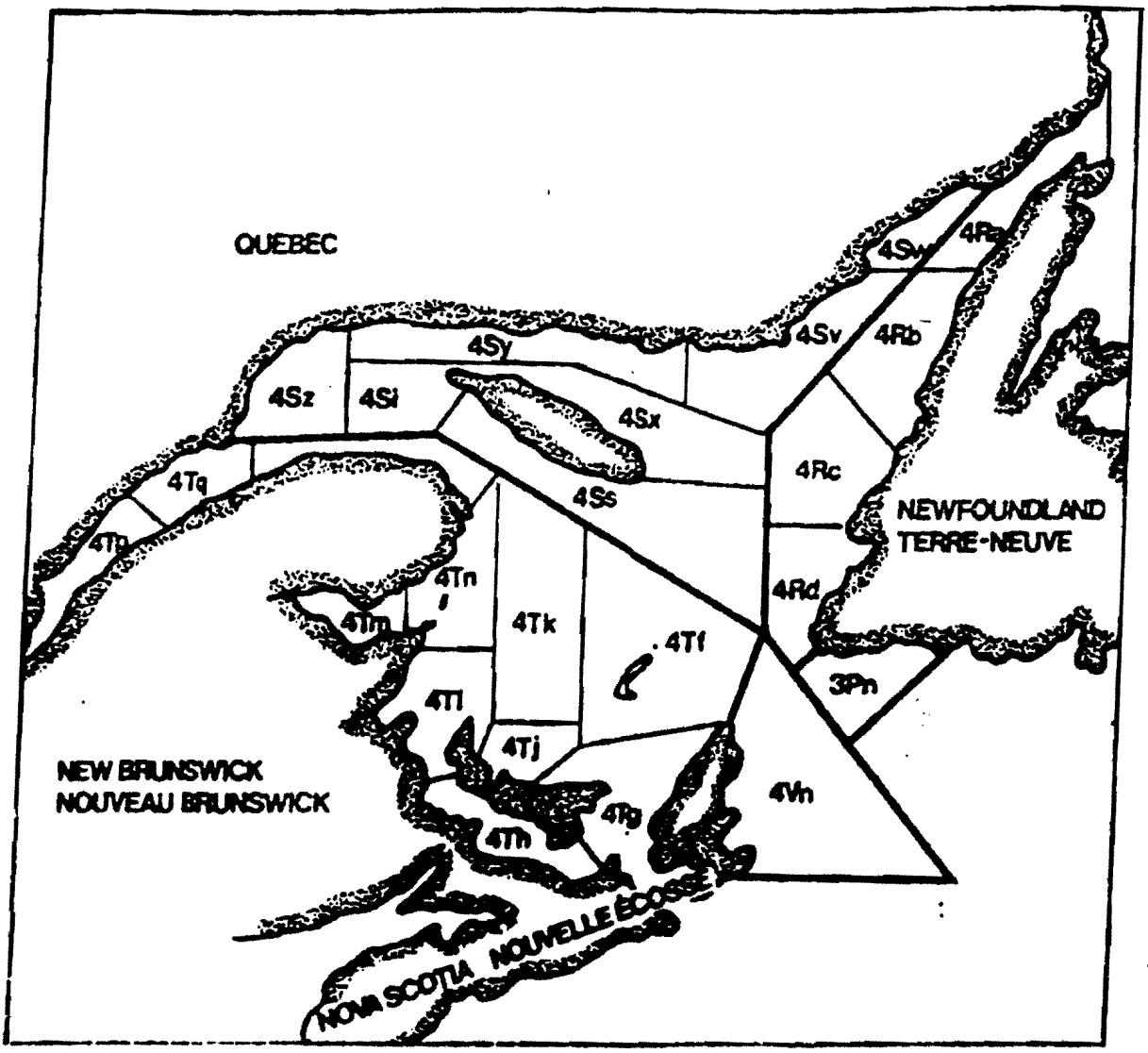


Figure 2 Gulf of St. Lawrence.

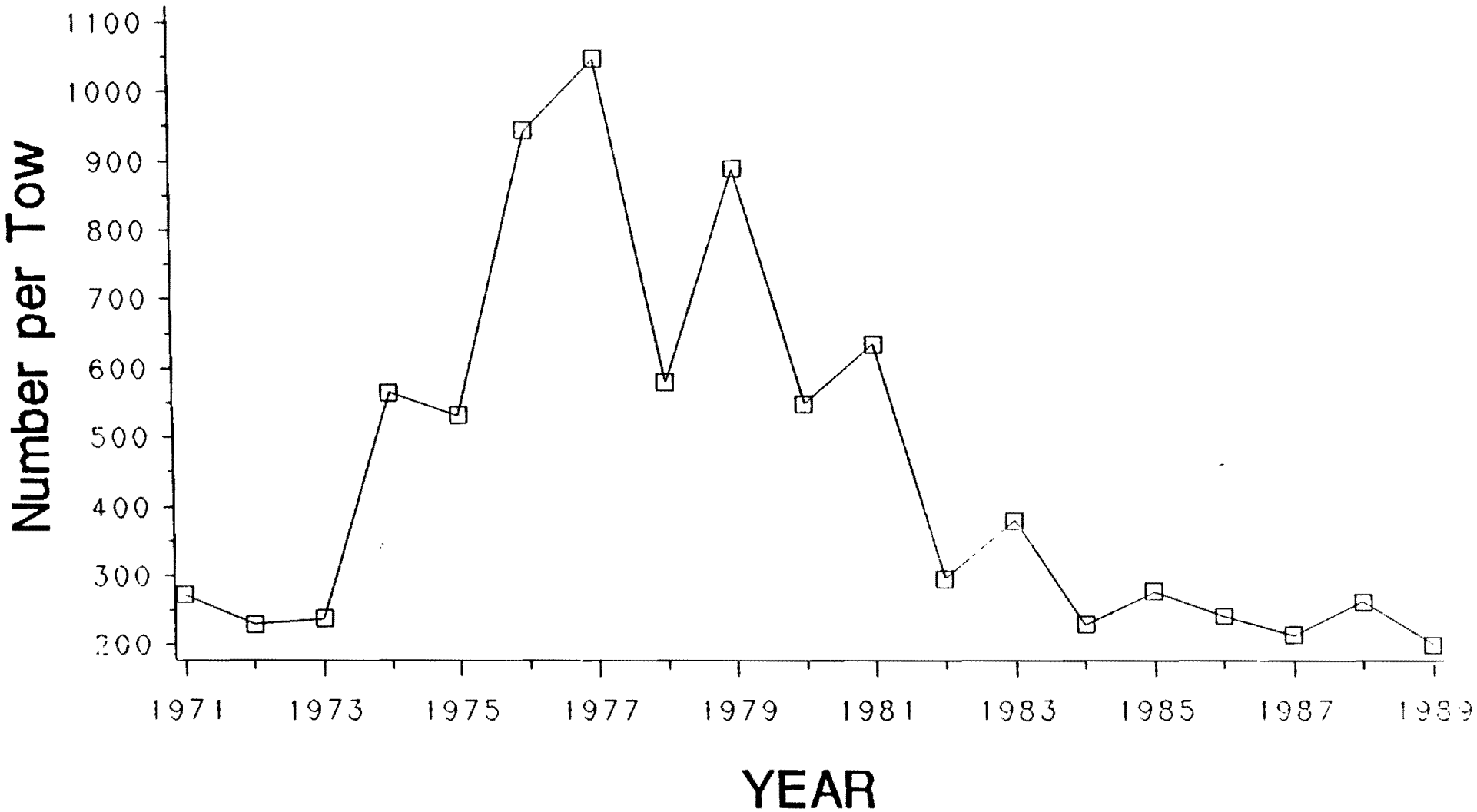


Figure 3. Mean number per tow from research vessel survey.

Appendix 1

The formulation used for ADAPT with RV data is as follows:

Parameters:

- Population estimate

  $N_{13,1989}$

- Calibration coefficients

  K_2 for RV survey data, ages 4-15 disaggregated

Structure:

- Error in catch at age assumed to be negligible
- Natural mortality assumed to be 0.2
- F oldest age group set equal to F for ages 15-19
- no PR was assumed for 1989
- Intercepts fitted

Input:

- $C_{i,t}$ i = 4-20 t = 1976-1988
- $RV_{i,t}$ i= 4-14 t = 1976-1989

Objective Function:

- Minimize

$$\sum_t (obs(RV_t)-pred(RV_t))^2$$

An alternative formulation (log model) used for ADAPT with RV data is as follows:

Parameters:

-Population estimate

$N_{13,1989}$

-Calibration coefficients

K_2 for RV survey data, ages 4-15 disaggregated

Structure:

- Error in catch at age assumed to be negligible
- Natural mortality assumed to be 0.2
- F oldest age group set equal to F for ages 15-19
- no PR was assumed for 1989
- Intercepts fitted

Input:

- $C_{i,t}$ i = 4-20 t = 1976-1988
- $RV_{i,t}$ i= 4-14 t = 1976-1989

Objective Function:

- Minimize

$$\sum_t \ln(obs(RV_t)-pred(RV_t))^2$$

Appendix 2

Catch rate tables and Figures plus age by age plots from Adaptive Framework Model

directed catch rate standardization.

REGRESSION OF MULTIPLICATIVE MODEL

MULTIPLE R..... .635
MULTIPLE R SQUARED..... .404

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUMS OF SQUARES	MEAN SQUARES	F-VALUE
INTERCEPT	1	8.834E0002	8.834E0002	
REGRESSION	32	6.132E0001	1.916E0000	7.048
TYPE 1	12	2.053E0001	1.711E0000	6.293
TYPE 2	9	1.659E0001	2.073E0000	7.625
TYPE 3	12	1.001E0001	8.342E-001	3.083
RESIDUALS	333	9.054E0001	2.719E-001	
TOTAL	366	1.035E0003		

REGRESSION COEFFICIENTS

CATEGORY	CODE	VARIABLE	COEFFICIENT	STD. ERROR	NO. OBS.
1	2114	INTERCEPT	-1.965	0.355	366
2	5				
3	77				
1	2112	1	-0.294	0.342	16
	2113	2	0.627	0.321	37
	2121	3	0.460	0.365	10
	2122	4	1.019	0.345	14
	2123	5	0.638	0.323	43
	2211	6	0.399	0.368	9
	2212	7	0.475	0.320	113
	2213	8	0.663	0.320	78
	2222	9	0.324	0.355	13
	2223	10	0.549	0.340	16
	3113	11	1.462	0.493	2
	28221	12	0.239	0.361	12
2	4	13	0.290	0.142	25
	6	14	-0.113	0.111	50
	7	15	-0.334	0.112	47
	8	16	-0.305	0.111	49
	9	17	-0.365	0.108	57
	10	18	-0.140	0.109	53
	11	19	0.201	0.120	37
	12	20	0.676	0.254	5
3	78	21	0.139	0.130	29
	79	22	0.251	0.121	37
	80	23	0.196	0.130	29
	81	24	0.314	0.135	25
	82	25	0.068	0.168	14
	83	26	0.060	0.161	16
	84	27	-0.213	0.117	50
	85	28	-0.074	0.282	4
	86	29	-0.196	0.144	24
	87	30	0.005	0.129	38
	88	31	-0.222	0.145	29
	89	32	-0.142	0.138	29

PREDICTED CATCH RATE

STANDARDS USED VARIABLE NUMBERS: 2114 5

YEAR	TOTAL CATCH	PROP.	CATCH RATE MEAN	CATCH RATE S.E.	EFFORT
77	9320	0.446	0.152	0.049	61279
78	9031	0.361	0.174	0.053	51997
79	10086	0.279	0.196	0.062	51469
80	8292	0.206	0.185	0.061	44939
81	7834	0.190	0.207	0.069	37774
82	6542	0.264	0.161	0.056	40566
83	6094	0.291	0.160	0.055	38047
84	9527	0.292	0.123	0.040	76491
85	9490	0.008	0.136	0.055	69597
86	7175	0.113	0.124	0.042	57691
87	7794	0.163	0.152	0.050	51166
88	6707	0.124	0.121	0.041	55356
89	4987	0.108	0.131	0.044	37957

AVERAGE C.V. FOR THE MEAN: .338

catch rate standardization.

REGRESSION OF MULTIPLICATIVE MODEL

MULTIPLE R..... .796
MULTIPLE R SQUARED..... .634

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUMS OF SQUARES	MEAN SQUARES	F-VALUE
INTERCEPT	1	8.273E0003	8.273E0003	
REGRESSION	43	5.630E0002	1.309E0001	33.441
TYPE 1	11	3.377E0002	3.070E0001	78.401
TYPE 2	9	4.191E0001	4.657E0000	11.893
TYPE 3	23	1.230E0002	5.347E0000	13.657
RESIDUALS	829	3.246E0002	3.915E0001	
TOTAL	873	9.161E0003		

REGRESSION COEFFICIENTS

CATEGORY	CODE	VARIABLE	COEFFICIENT	STD. ERROR	NO. OBS.
1	2112	INTERCEPT	3.764	0.183	873
2	5				
3	66				
1	2113	1	0.764	0.068	214
	2114	2	1.440	0.109	55
	2122	3	1.200	0.322	4
	2123	4	1.090	0.089	85
	2124	5	1.617	0.140	29
	2212	6	1.633	0.080	117
	2213	7	1.755	0.061	114
	2222	8	1.907	0.189	14
	2223	9	2.013	0.056	64
	3113	10	1.339	0.280	5
	3114	11	1.504	0.154	23
2	1	12	-0.697	0.190	14
	4	13	0.488	0.095	68
	6	14	-0.117	0.083	104
	7	15	-0.202	0.088	88
	8	16	-0.015	0.086	94
	9	17	0.166	0.086	92
	10	18	0.227	0.082	111
	11	19	0.283	0.084	98
	12	20	0.365	0.101	61
3	67	21	-0.270	0.201	30
	68	22	-0.037	0.203	30
	69	23	-0.152	0.194	38
	70	24	-0.218	0.192	38
	71	25	-0.231	0.189	43
	72	26	-0.437	0.193	37
	73	27	-0.512	0.193	38
	74	28	-0.443	0.206	26
	75	29	-0.747	0.213	22
	76	30	-0.357	0.209	25
	77	31	-0.014	0.198	35
	78	32	-0.090	0.196	38
	79	33	-0.297	0.185	59
	80	34	-0.229	0.188	55
	81	35	-0.524	0.188	54
	82	36	-0.932	0.189	50
	83	37	-0.740	0.193	41
	84	38	-1.382	0.191	52
	85	39	-0.809	0.195	40
	86	40	-1.047	0.204	30
	87	41	-0.526	0.226	18
	88	42	-0.986	0.208	27
	89	43	-1.424	0.207	31

Table D. Standardized catch rate for cod directed fishery.

PREDICTED CATCH RATE

STANDARDS USED VARIABLE NUMBERS: 2112 5

YEAR	TOTAL CATCH	PROP.	CATCH RATE MEAN	S.E.	EFFORT
66	11780	0.233	0.028	0.005	424560
67	9351	0.297	0.021	0.003	438034
68	9568	0.326	0.027	0.004	355267
69	8192	0.296	0.024	0.003	340630
70	9201	0.282	0.023	0.003	406785
71	9513	0.311	0.021	0.003	454475
72	6294	0.383	0.018	0.002	458715
73	7047	0.252	0.017	0.002	420168
74	8465	0.169	0.018	0.003	472890
75	8443	0.193	0.013	0.002	638395
76	11152	0.094	0.020	0.003	572572
77	9320	0.291	0.028	0.003	337743
78	9031	0.329	0.026	0.003	352890
79	10086	0.333	0.021	0.002	484134
80	8292	0.365	0.022	0.002	371885
81	7834	0.297	0.017	0.002	472043
82	6542	0.292	0.011	0.001	592799
83	6094	0.283	0.013	0.002	456129
84	9627	0.186	0.007	0.001	1367525
85	9490	0.145	0.012	0.002	761326
86	7175	0.100	0.010	0.001	731047
87	7794	0.070	0.015	0.002	523415
88	6707	0.096	0.010	0.001	643567
89	4987	0.152	0.007	0.001	741856

AVERAGE C.V. FOR THE MEAN: .131

Table E. ANOVA and regression coefficients from the plaice and cod (combined) directed catch rate standardization.

REGRESSION OF MULTIPLICATIVE MODEL

MULTIPLE R..... .689
MULTIPLE R SQUARED..... .474

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUMS OF SQUARES	MEAN SQUARES	F-VALUE
INTERCEPT	1	8.728E0003	8.728E0003	
REGRESSION	45	7.789E0002	1.731E0001	24.074
TYPE 1	13	5.415E0002	4.166E0001	57.936
TYPE 2	9	5.143E0001	5.714E0000	7.947
TYPE 3	23	1.485E0002	6.454E0000	8.977
RESIDUALS	1202	8.642E0002	7.190E-001	
TOTAL	1248	1.037E0004		

REGRESSION COEFFICIENTS

CATEGORY	CODE	VARIABLE	COEFFICIENT	STD. ERROR	NO. OBS.
1	2122	INTERCEPT	-1.655	0.312	1249
2	5				
3	56				
1	2112	1	-2.357	0.217	163
	2113	2	-1.456	0.212	251
	2114	3	-0.913	0.243	59
	2121	4	-0.957	0.281	20
	2123	5	-1.010	0.217	128
	2124	6	-0.664	0.272	29
	2211	7	-0.063	0.340	10
	2212	8	-0.365	0.212	230
	2213	9	-0.428	0.214	192
	2222	10	-0.468	0.264	27
	2223	11	-0.385	0.227	80
	3114	12	-0.809	0.267	23
	23221	13	-0.299	0.293	18
2	1	14	-0.566	0.270	12
	4	15	0.608	0.111	90
	6	16	-0.032	0.093	156
	7	17	-0.134	0.097	136
	8	18	0.014	0.096	145
	9	19	0.137	0.095	151
	10	20	0.209	0.092	167
	11	21	0.352	0.096	137
	12	22	0.286	0.127	66
3	67	23	-0.156	0.274	28
	68	24	0.138	0.277	27
	69	25	-0.014	0.261	38
	70	26	-0.103	0.259	38
	71	27	-0.184	0.255	43
	72	28	-0.321	0.261	37
	73	29	-0.394	0.260	38
	74	30	-0.274	0.276	26
	75	31	-0.587	0.286	22
	76	32	-0.208	0.260	35
	77	33	0.500	0.245	76
	78	34	0.438	0.247	66
	79	35	0.247	0.240	96
	80	36	0.176	0.242	83
	81	37	0.025	0.244	79
	82	38	-0.563	0.248	64
	83	39	-0.340	0.250	57
	84	40	-0.479	0.239	102
	85	41	-0.615	0.259	44
	86	42	-0.367	0.253	54
	87	43	0.156	0.253	60
	88	44	-0.429	0.253	63
	89	45	-0.652	0.251	66

Table F. Standardized catch rate for combined plaice and cod directed fishery.

PREDICTED CATCH RATE

STANDARDS USED VARIABLE NUMBERS: 2122 5

YEAR	TOTAL CATCH	PROP.	CATCH RATE MEAN	CATCH RATE S.E.	EFFORT
66	11780	0.233	0.261	0.080	45153
67	9351	0.292	0.226	0.060	41395
68	9568	0.298	0.303	0.081	31550
69	8192	0.295	0.261	0.067	31377
70	9201	0.282	0.229	0.061	38508
71	9513	0.311	0.221	0.055	43115
72	8294	0.333	0.192	0.049	43186
73	7047	0.252	0.179	0.045	39465
74	8485	0.169	0.200	0.054	42350
75	8443	0.133	0.146	0.041	57745
76	11192	0.094	0.214	0.058	52259
77	9320	0.729	0.439	0.101	21230
78	9031	0.576	0.412	0.098	21901
79	10086	0.613	0.342	0.077	29529
80	8292	0.570	0.318	0.073	26078
81	7834	0.487	0.273	0.064	28690
82	6542	0.555	0.152	0.036	43155
83	6094	0.574	0.189	0.046	32206
84	9627	0.479	0.165	0.038	58297
85	9490	0.154	0.144	0.035	66029
86	7175	0.213	0.184	0.044	38953
87	7794	0.241	0.312	0.071	25001
88	6707	0.242	0.173	0.041	38674
89	4987	0.276	0.139	0.032	35925

AVERAGE C.V. FOR THE MEAN: .249

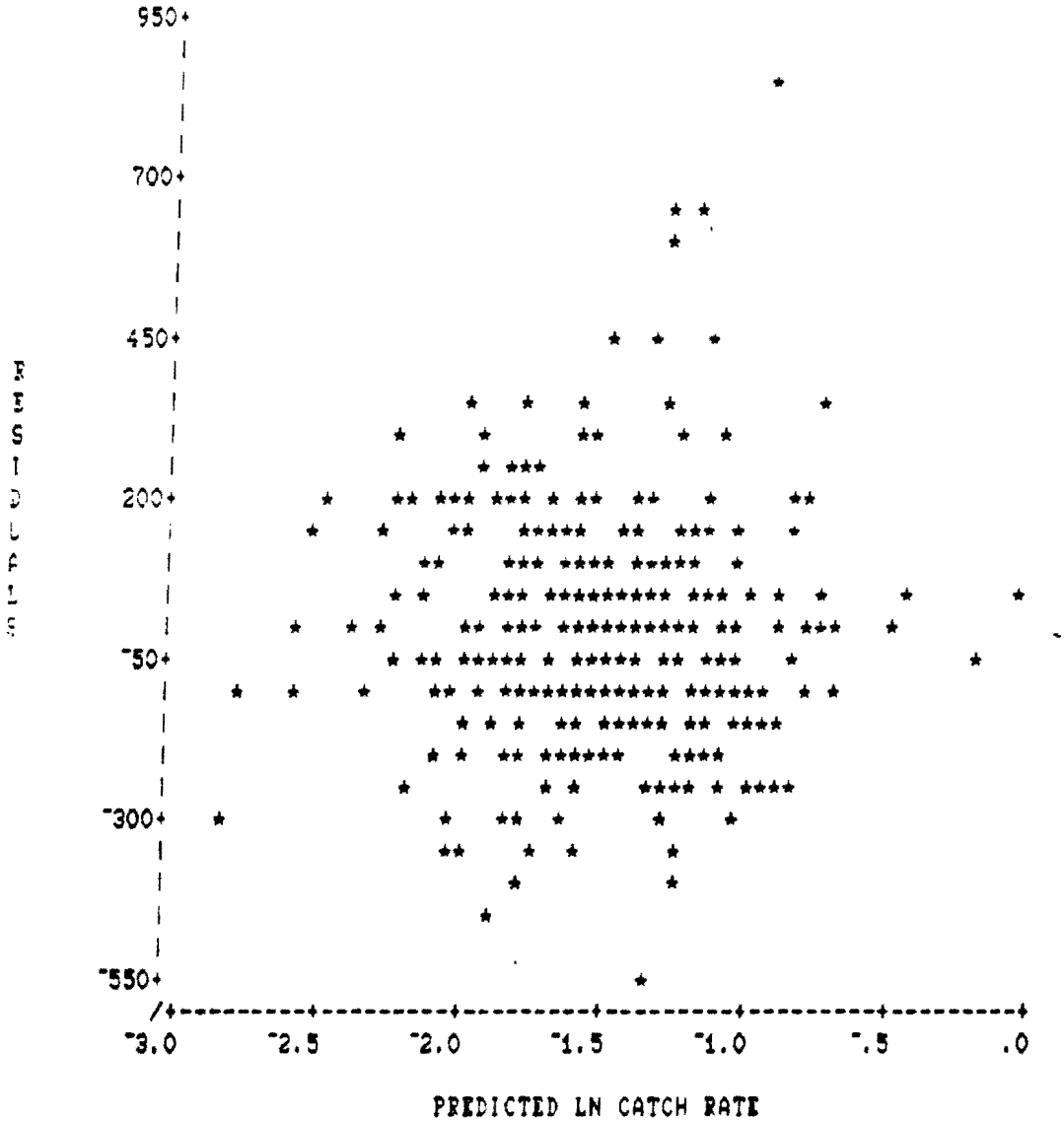


Figure Aa. Residuals versus predicted in catch rate for plaice directed run of the multiplicative model.

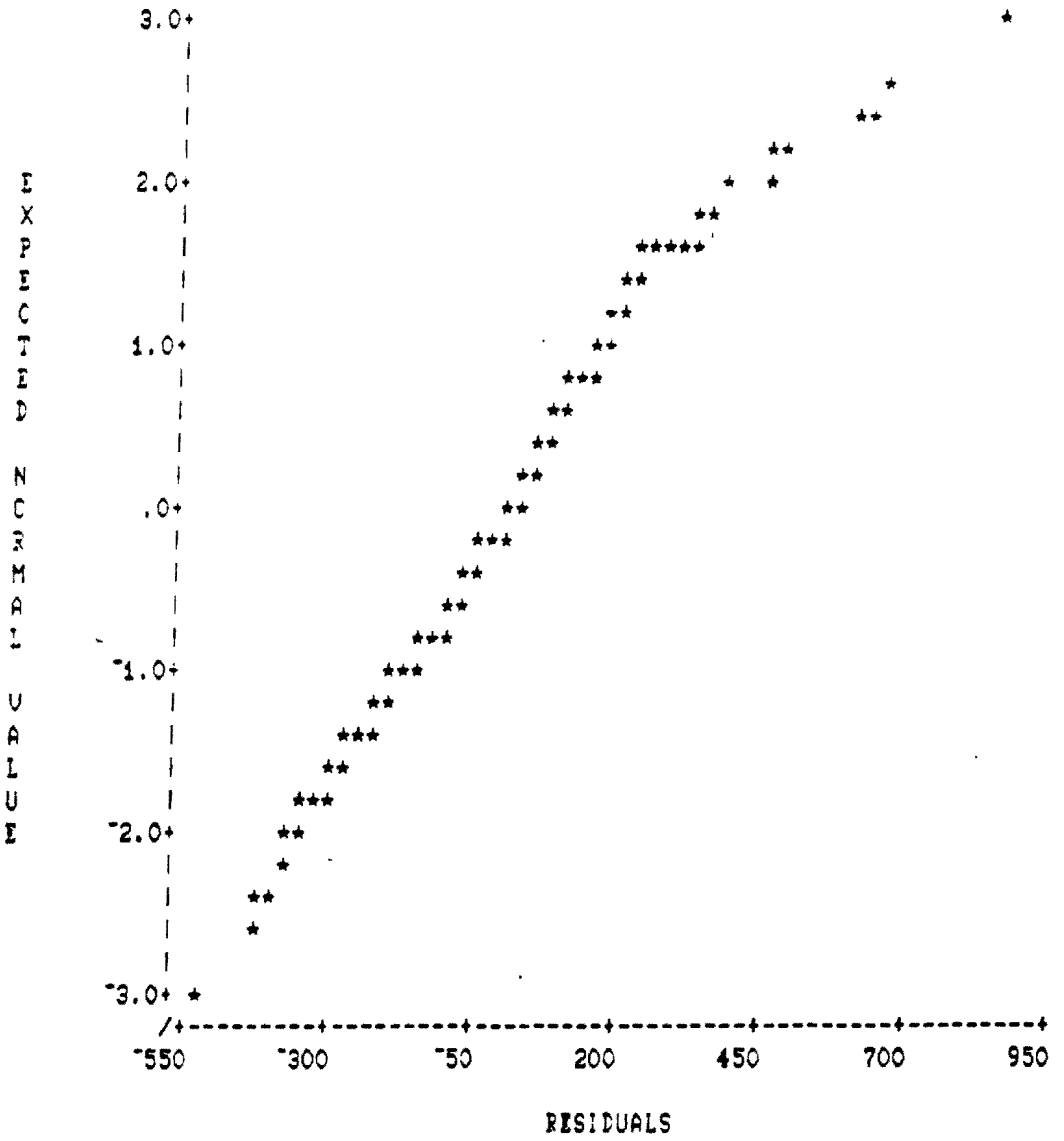


Figure Ab. Plot of normalized residuals of plaice directed run of the multiplicative model.

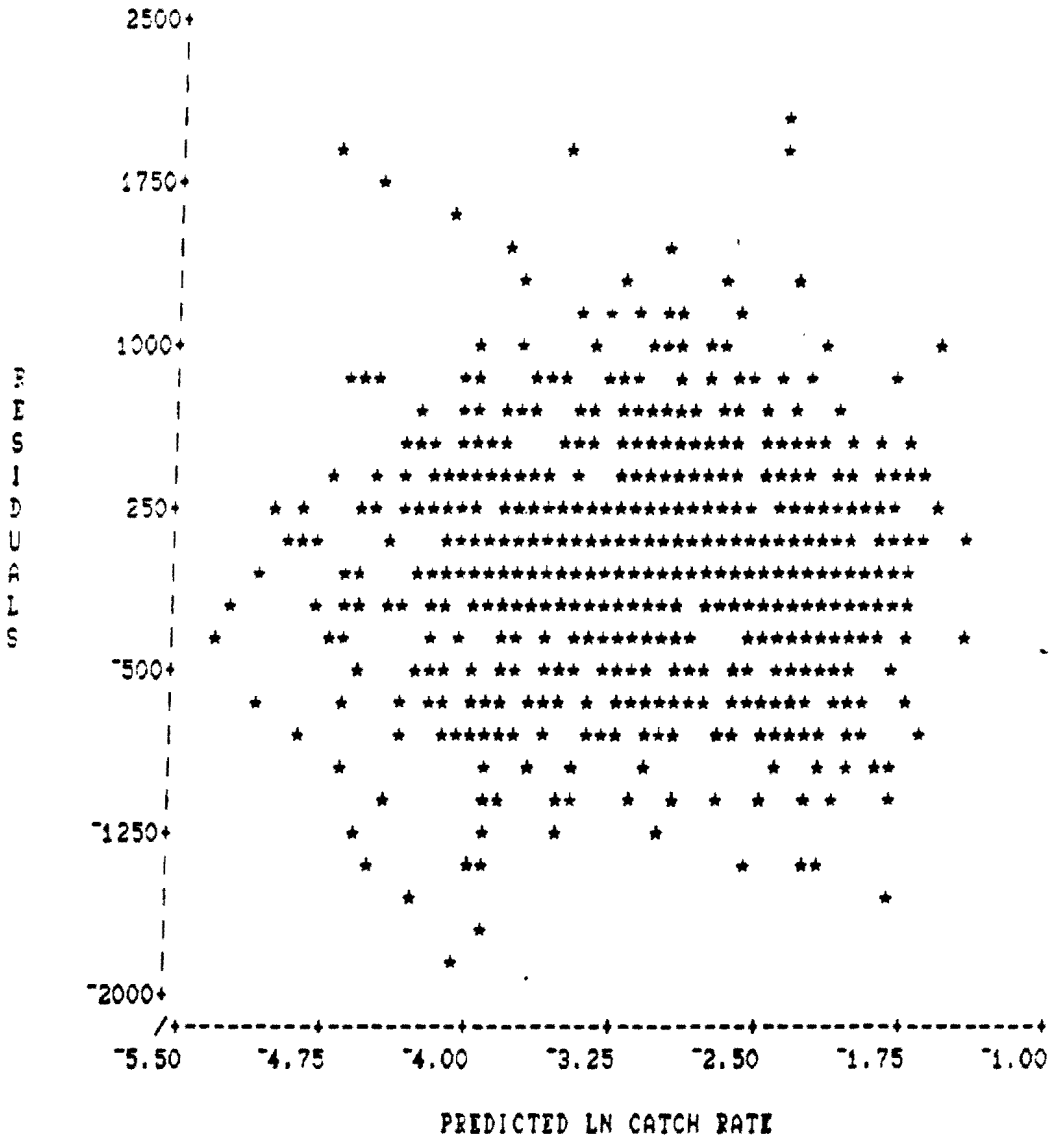


Figure Ba. Residuals versus predicted in catch rate for cod directed run of the multiplicative model.

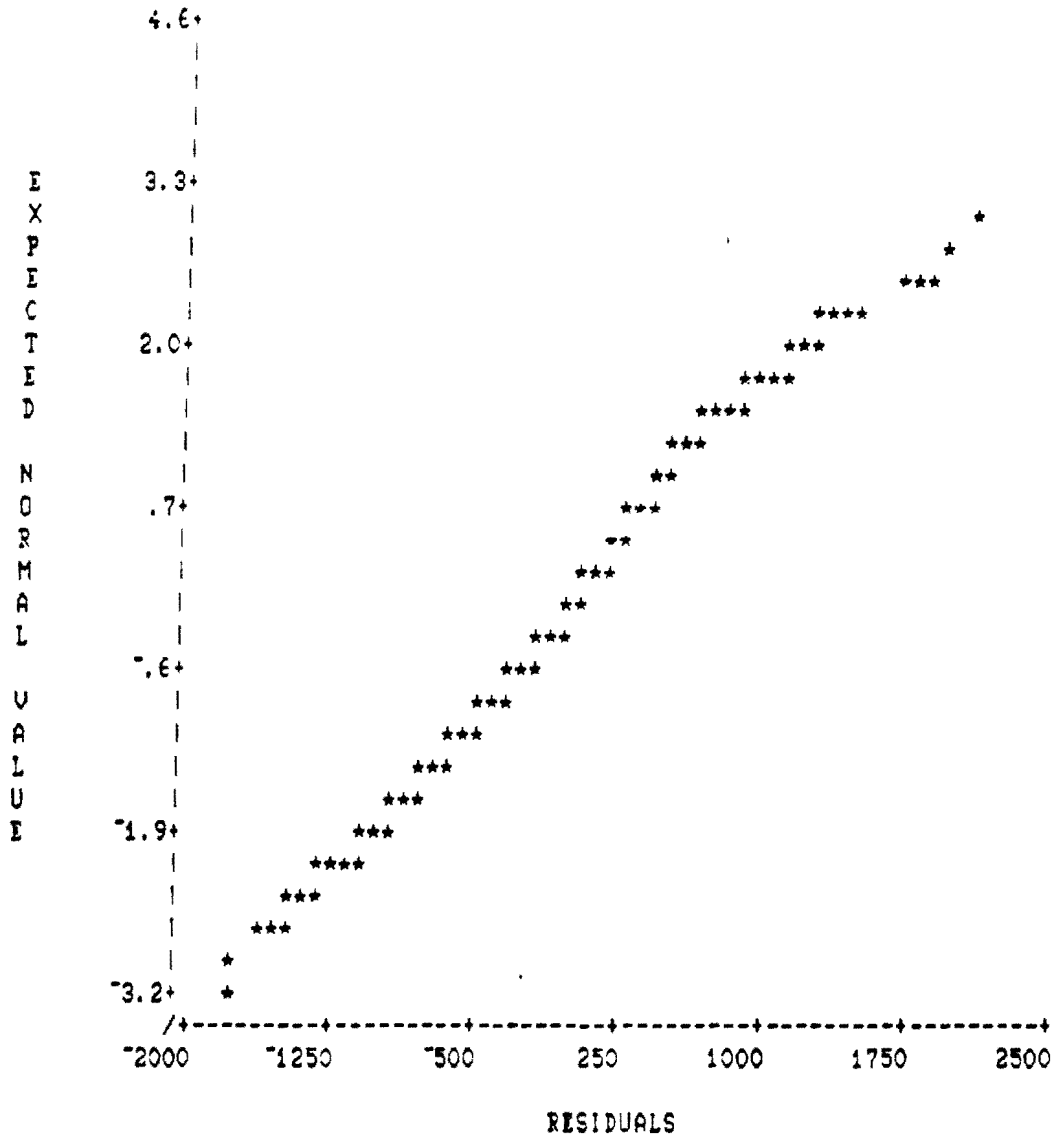


Figure Bb. Plot of normalized residuals of cod directed run of the multiplicative model.

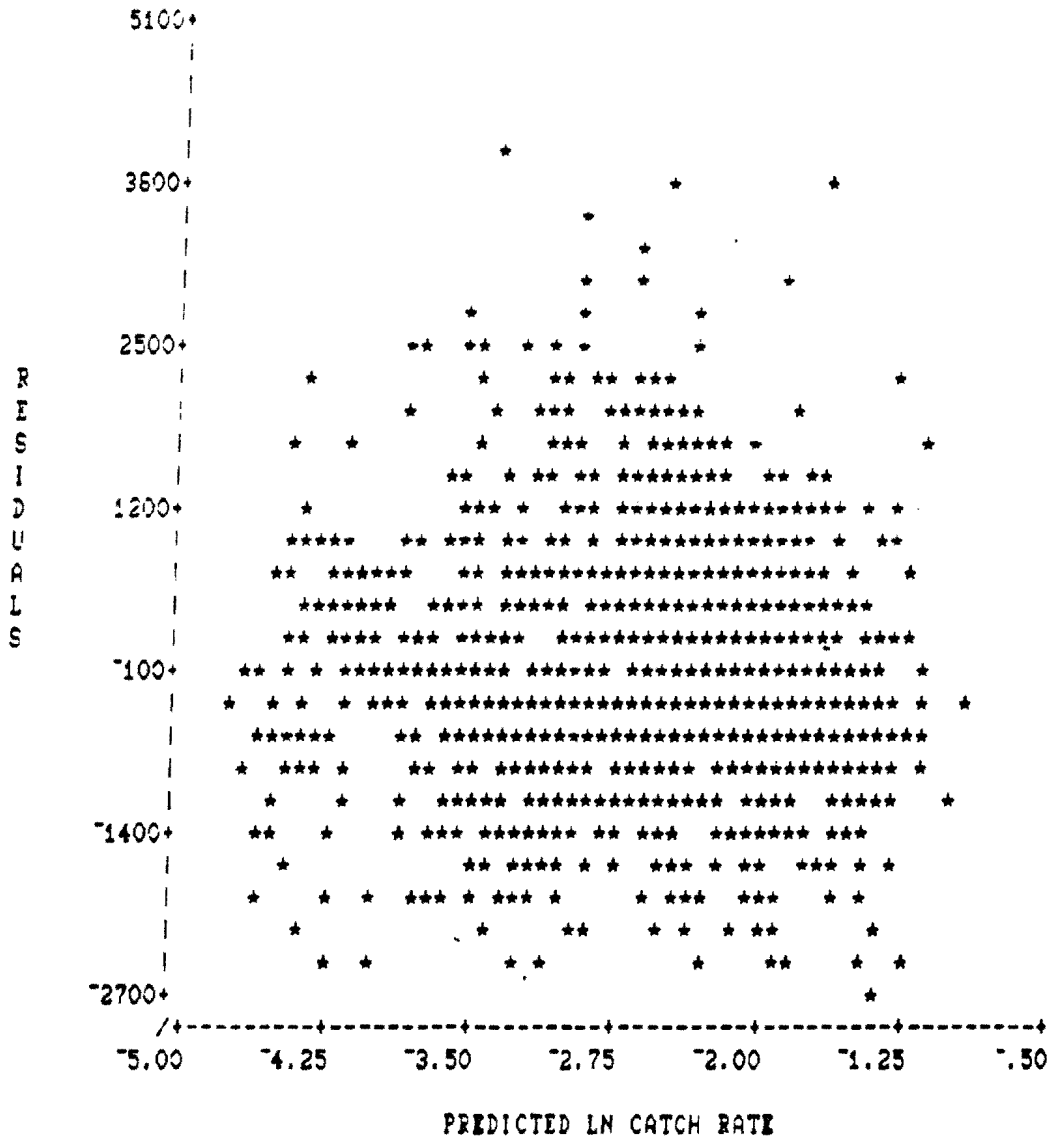


Figure Ca. Residuals versus predicted in catch rate for combined plaice directed and cod directed run of the multiplicative model.

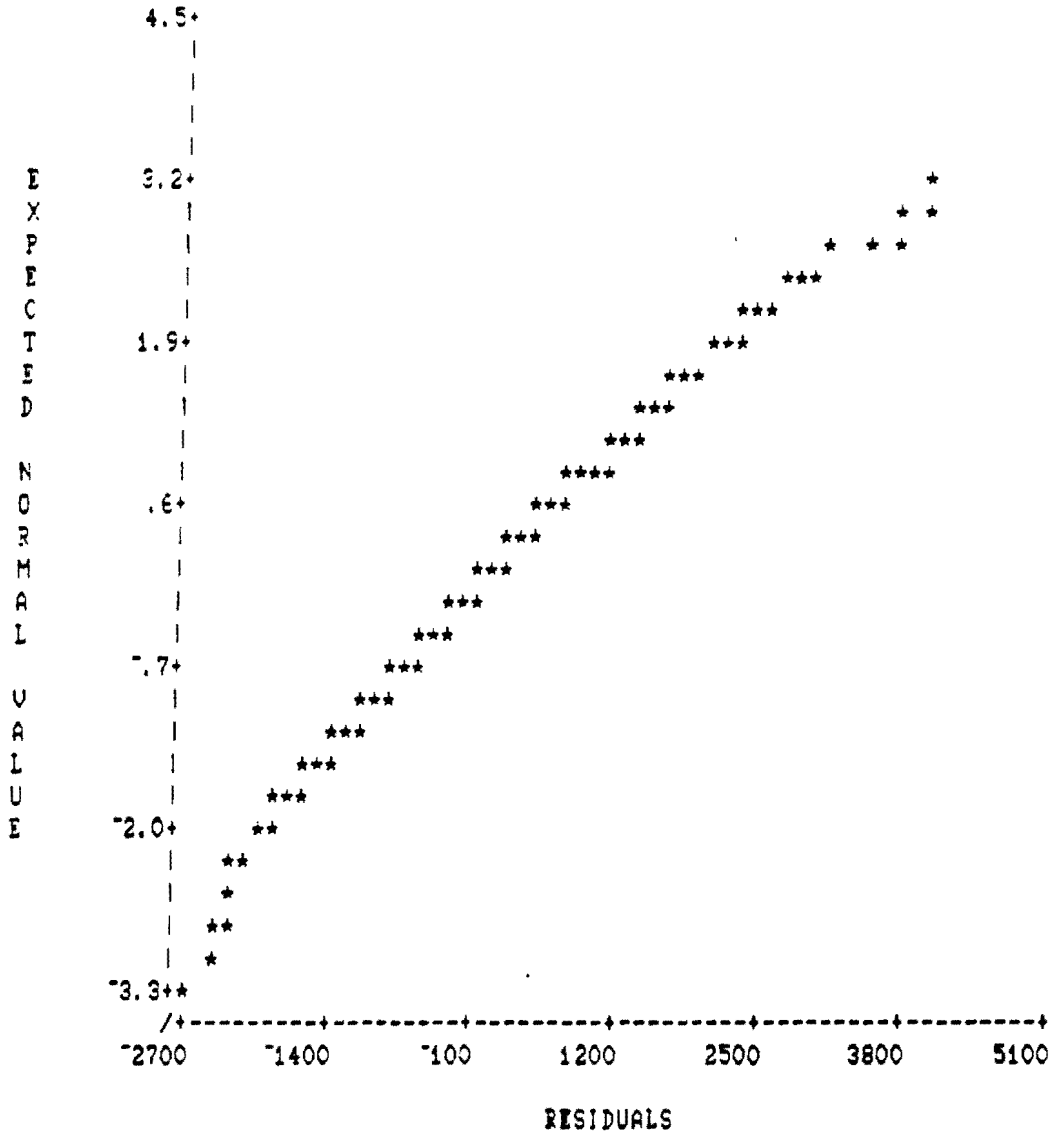


Figure Cb. Plot of normalized residuals of combined plaice directed and cod directed run of the multiplicative model.

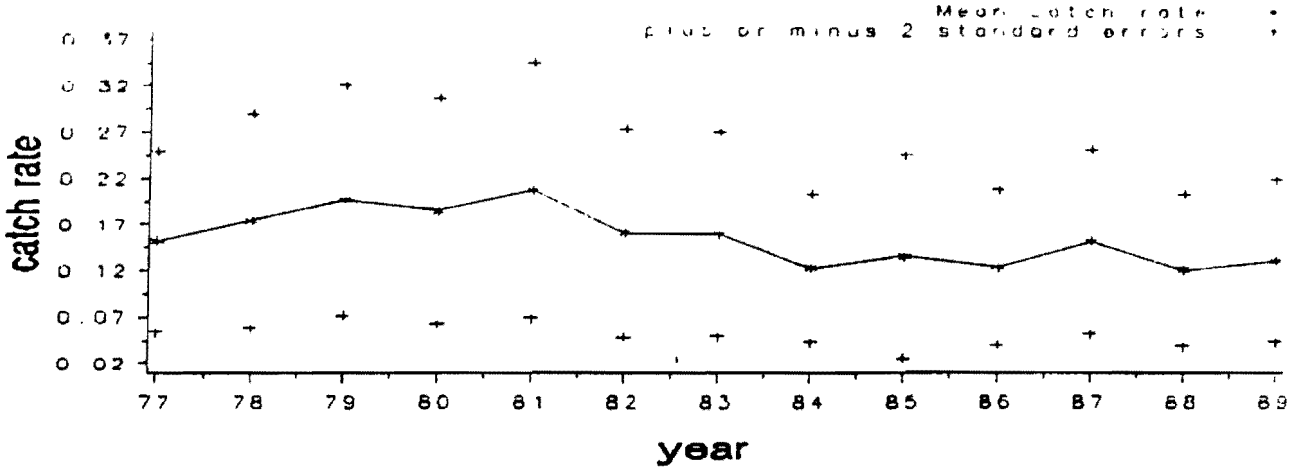


Figure D. Catch rate from plaice directed plaice fishery in NAFO Div. 4T

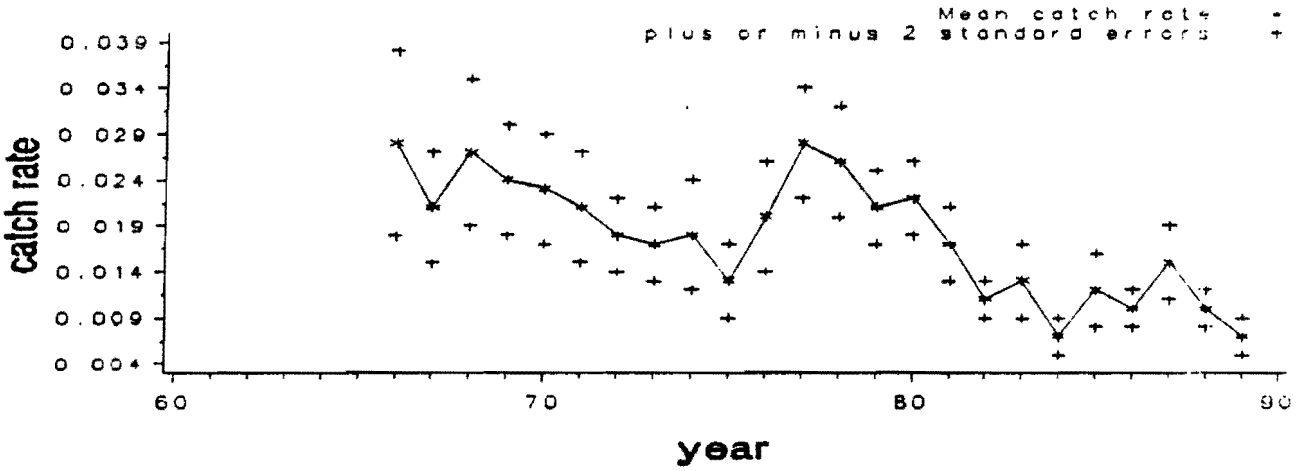


Figure E. Catch rate from cod directed plaice fishery in NAFO Div. 4T

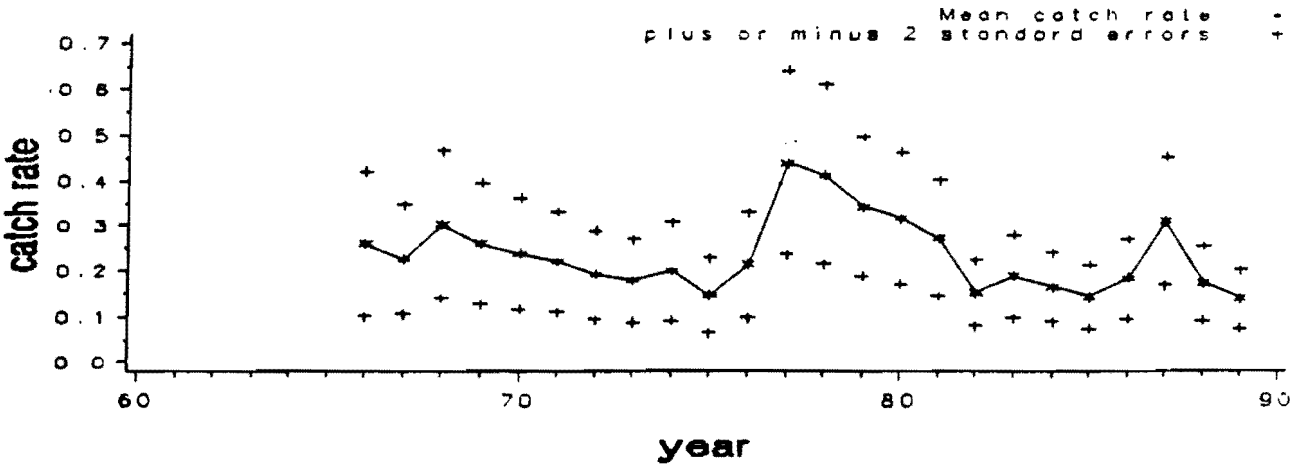
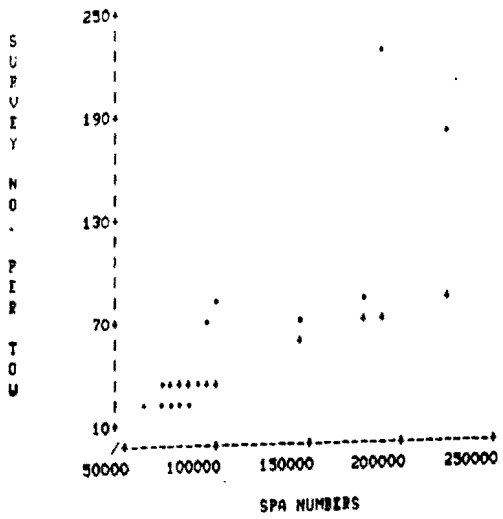


Figure F. Catch rate from combined fishery in NAFO Div. 4T

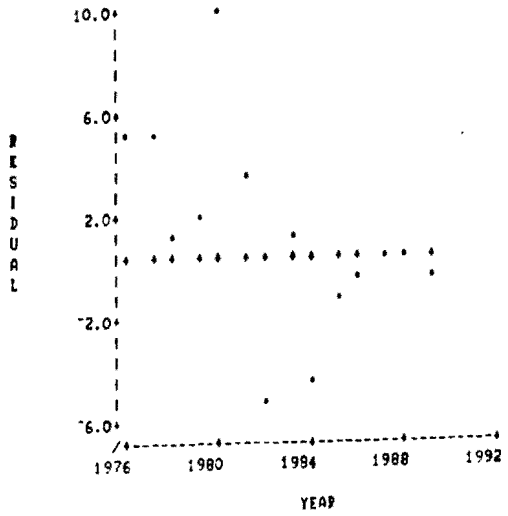
4T PLAICE TUNING MAY 1990

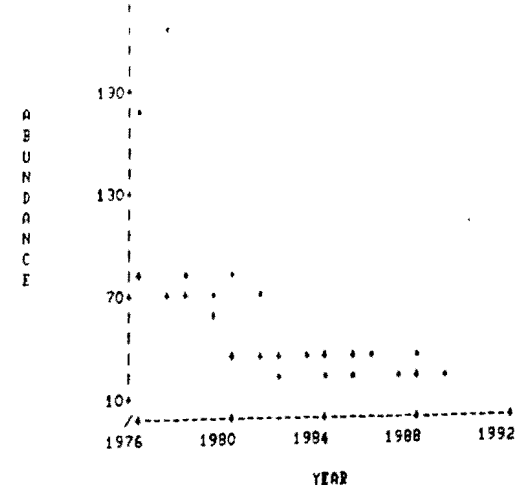
. 4T

AGE 4 PLOTS
SURVEY NO. PER TOW VS SPA NUMBERS



TREND IN STANDARDIZED RESIDUAL OVER TIME





SUMMARY OF DATA FROM PLOT
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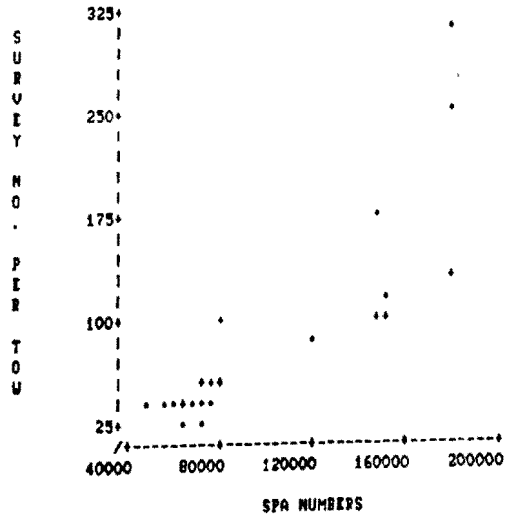
CARRIER VARIABLE: POPULATION NOS
RESPONSE VARIABLE(S): SURVEY - O:OBSERVED, +:PREDICTED

INDEX	CARRIER	O	+	RANK
1976	2.232E5	175.2	84.01	1987
1977	1.885E5	228.8	70.96	1988
1978	1.81E5	83.33	68.13	1989
1979	1.46E5	66.07	54.97	1982
1980	9.848E4	80.13	37.07	1985
1981	9.365E4	72.8	35.25	1984
1982	7.626E4	18.18	28.7	1986
1983	8.767E4	35.37	33	1983
1984	8.518E4	23.95	32.06	1981
1985	7.818E4	22.11	29.43	1980
1986	8.752E4	32.01	32.95	1979
1987	5.983E4	24.31	22.52	1978
1988	6.959E4	28.29	26.19	1977
1989	7.181E4	26.98	27.03	1976

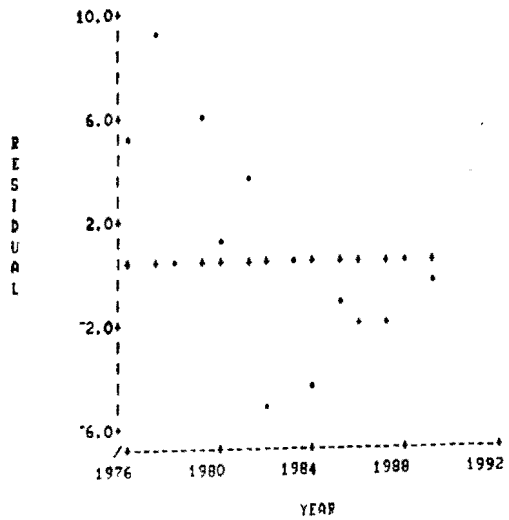
4T PLAICE TUNING MAY 1990

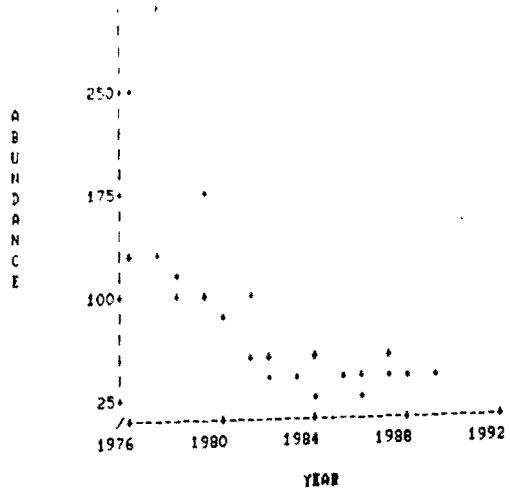
- 4T

AGE 5 PLOTS
SURVEY NO. PER TOW VS SPA NUMBERS



TREND IN STANDARDIZED RESIDUAL OVER TIME





SUMMARY OF DATA FROM PLOT

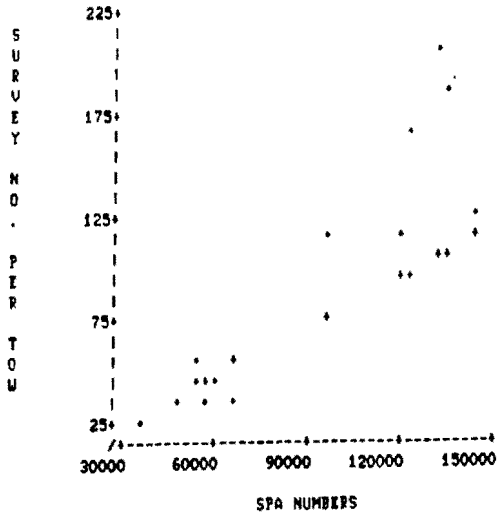
CARRIER VARIABLE: POPULATION NOS
RESPONSE VARIABLE(S): SURVEY - O:OBSERVED, +:PREDICTED

INDEX	CARRIER	+	*	RANK
1976	1.799E5	257.1	124.5	1988
1977	1.792E5	212.3	124.1	1989
1978	1.532E5	110.2	106	1983
1979	1.476E5	181.4	102.2	1986
1980	1.189E5	90.62	82.29	1985
1981	8.032E4	97.81	55.61	1987
1982	7.611E4	34.73	52.69	1984
1983	6.161E4	43.37	42.65	1982
1984	7.117E4	32.29	49.27	1981
1985	6.843E4	41.75	47.38	1980
1986	6.292E4	28.52	43.56	1979
1987	7.038E4	36.39	48.73	1978
1988	4.827E4	34.54	33.42	1977
1989	5.517E4	37.4	38.19	1976

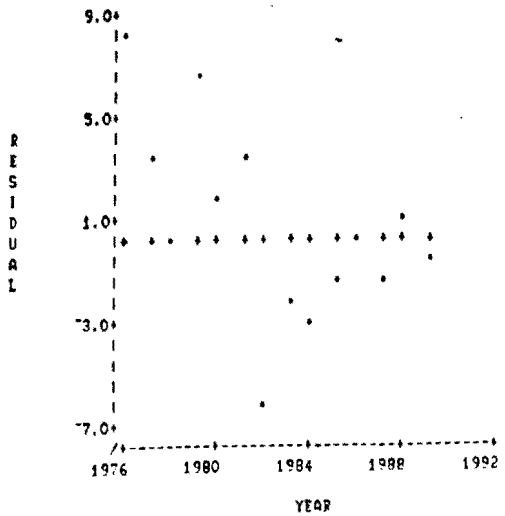
4T PLAICE TUNING MAY 1990

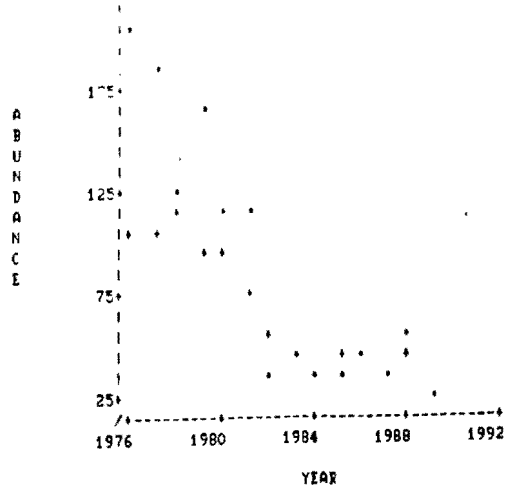
- 4T

AGE 6 PLOTS
SURVEY NO. PER TOW VS SPA NUMBERS



TREND IN STANDARDIZED RESIDUAL OVER TIME





SUMMARY OF DATA FROM PLOT
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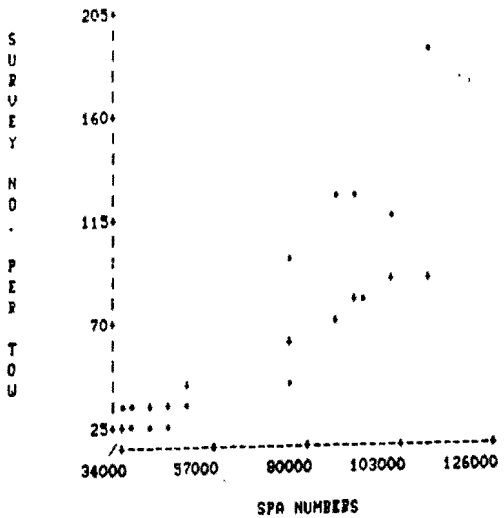
CARRIER VARIABLE: POPULATION NOS
RESPONSE VARIABLE(S): SURVEY - O:OBSERVED, +:PREDICTED

INDEX	CARRIER	+	O	RANK
1976	1.309E5	202.7	106.4	1989
1977	1.353E5	133	109.9	1987
1978	1.427E5	122.8	115.9	1984
1979	1.226E5	163.9	99.63	1986
1980	1.187E5	113	96.46	1988
1981	9.519E4	115.7	77.34	1985
1982	6.474E4	30.03	52.6	1983
1983	5.972E4	42.15	48.52	1982
1984	4.884E4	30.48	39.68	1981
1985	5.651E4	37.4	45.91	1980
1986	5.317E4	43.28	43.2	1979
1987	4.683E4	31.7	38.04	1976
1988	5.427E4	53.86	44.09	1977
1989	3.566E4	28.32	28.97	1978

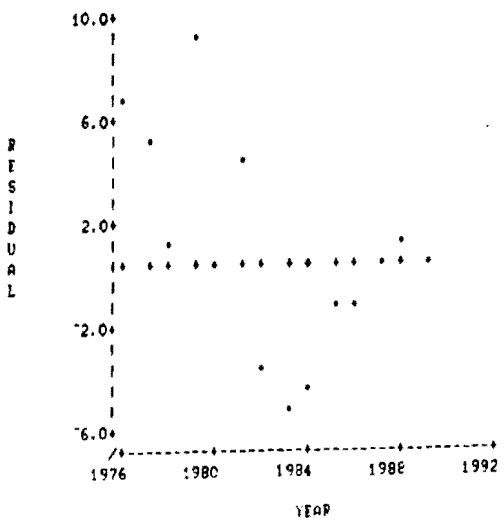
4T PLAICE TUNING MAY 1990

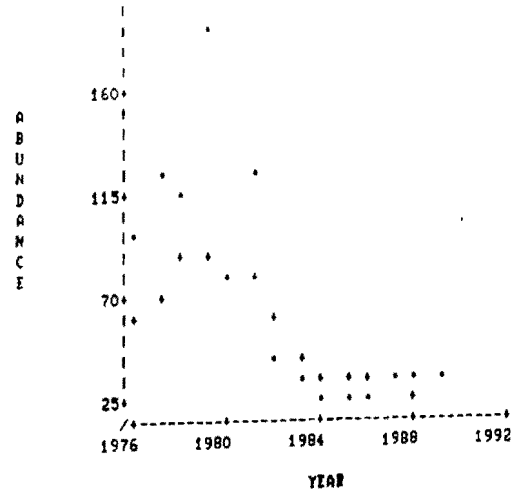
-4T

AGE 7 PLOTS
SURVEY NO. PER TOW VS SPA NUMBERS



TREND IN STANDARDIZED RESIDUAL OVER TIME





SUMMARY OF DATA FROM PLOT

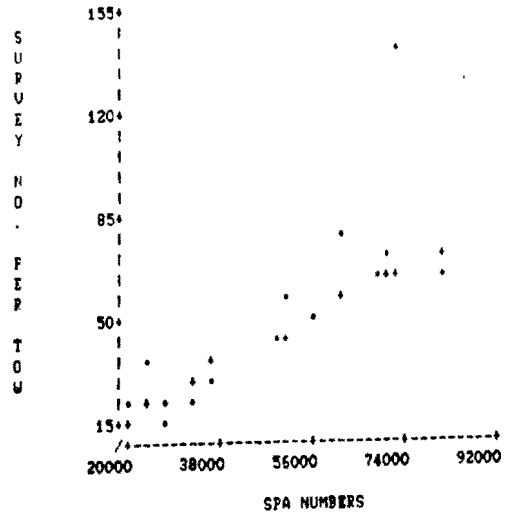
CARRIER VARIABLE: POPULATION NOS
RESPONSE VARIABLE(S): SURVEY - O:OBSERVED, +:PREDICTED

INDEX	CARRIER	+	+	RANK
1976	7.564E4	96.91	62.75	1988
1977	8.714E4	122	72.29	1989
1978	1.011E5	113.1	83.85	1987
1979	1.101E5	184.2	91.36	1985
1980	9.394E4	79.65	77.93	1986
1981	9.231E4	125.4	76.58	1984
1982	7.507E4	44.95	62.28	1983
1983	4.993E4	31.36	41.42	1982
1984	4.562E4	27.54	37.84	1976
1985	3.725E4	27.01	30.9	1977
1986	4.193E4	26.82	34.79	1981
1987	3.593E4	32.47	29.81	1980
1988	3.417E4	34.18	28.35	1978
1989	3.557E4	31.17	29.51	1979

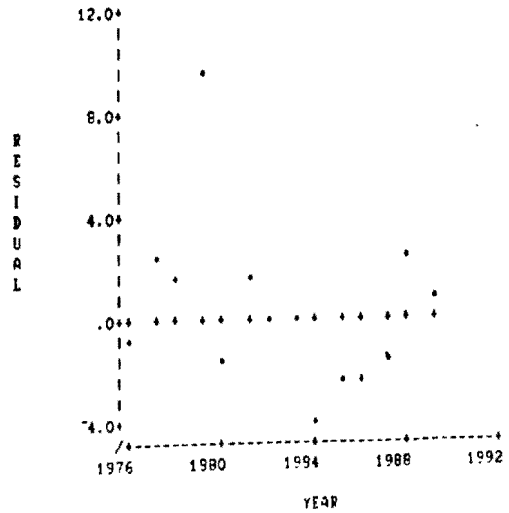
4T PLAICE TUNING MAY 1990

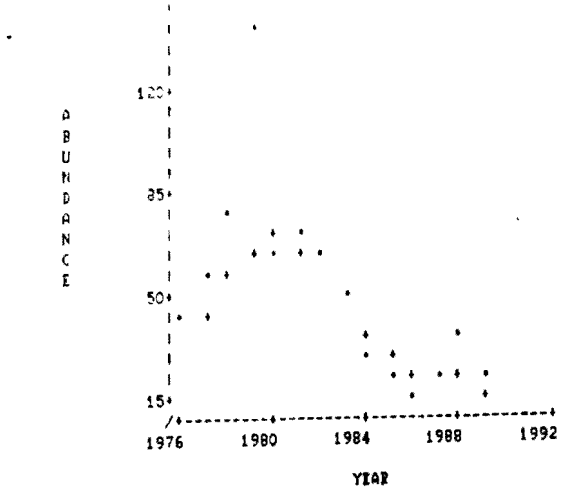
.4T

AGE 3 PLOTS
SURVEY NO. PER TOW VS SPA NUMBERS



TREND IN STANDARDIZED RESIDUAL OVER TIME





SUMMARY OF DATA FROM PLOT

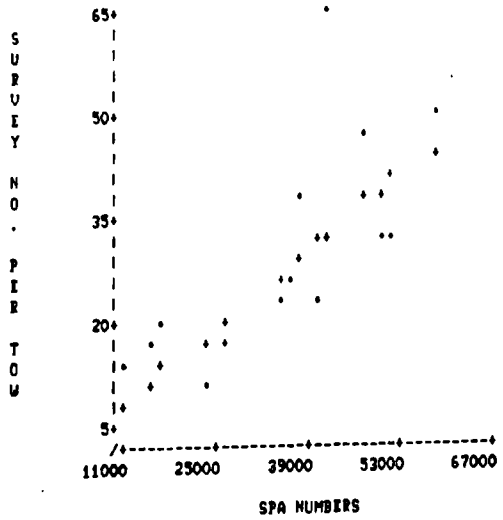
CARRIER VARIABLE: POPULATION NOS
RESPONSE VARIABLE(S): SURVEY - O:OBSERVED, *:PREDICTED

INDEX	CARRIER	*	*	RANK
1976	4.918E4	42.43	44.64	1989
1977	4.977E4	53.74	45.17	1988
1978	6.071E4	74.98	55.1	1986
1979	7.221E4	138.5	65.54	1987
1980	8.087E4	64.02	73.41	1985
1981	6.963E4	72.78	63.2	1984
1982	6.928E4	61.72	62.88	1976
1983	5.54E4	50.35	50.29	1977
1984	3.708E4	25.84	33.66	1983
1985	3.339E4	20.37	30.3	1978
1986	2.65E4	15.55	24.05	1982
1987	2.652E4	19.41	24.07	1981
1988	2.31E4	32.5	20.96	1979
1989	2.024E4	20.53	18.37	1980

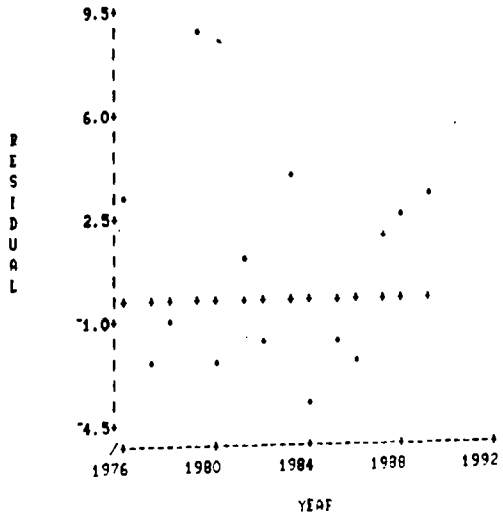
4T PLAICE TUNING MAY 1990

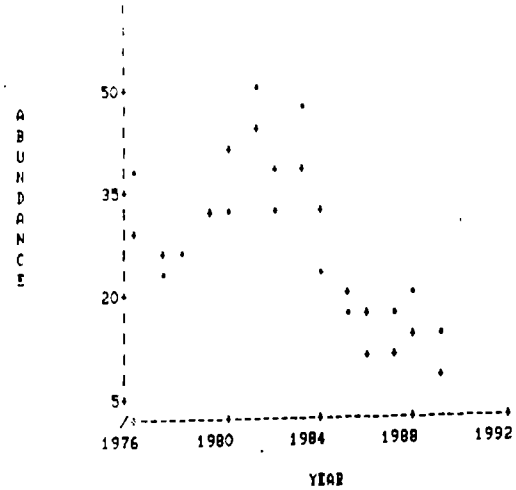
4T

AGE 9 PLOTS
SURVEY NO. PER TOW VS SPA NUMBERS



TREND IN STANDARDIZED RESIDUAL OVER TIME





SUMMARY OF DATA FROM PLOT

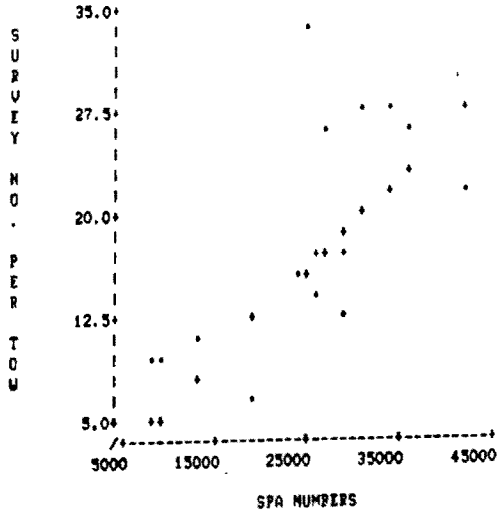
CARRIER VARIABLE: POPULATION NOS
RESPONSE VARIABLE(S): SURVEY - O:OBSERVED, +:PREDICTED

INDEX	CARRIER	*	*	RANK
1976	3.714E4	38.05	28.68	1989
1977	3.429E4	21.81	26.48	1987
1978	3.551E4	24.63	27.43	1988
1979	4.145E4	63.76	32.02	1986
1980	5.143E4	33.11	39.72	1985
1981	5.859E4	49.09	45.25	1977
1982	5.059E4	32.29	39.08	1978
1983	4.726E4	47.79	36.5	1976
1984	3.992E4	23.77	30.83	1984
1985	2.674E4	17.54	20.65	1979
1986	2.316E4	10.52	17.89	1983
1987	1.46E4	16.63	11.28	1982
1988	1.662E4	19.72	12.84	1980
1989	1.146E4	12.86	8.85	1981

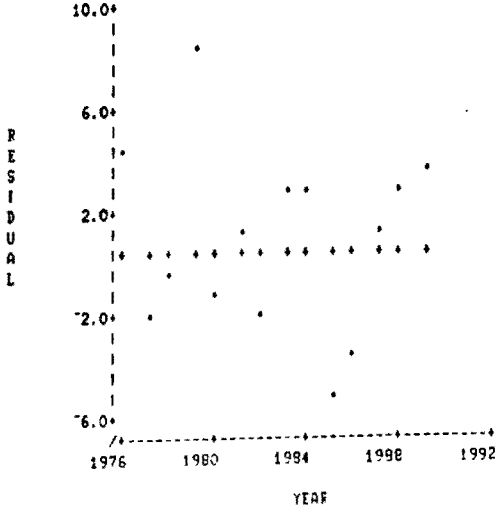
4T PLAICE TUNING MAY 1990

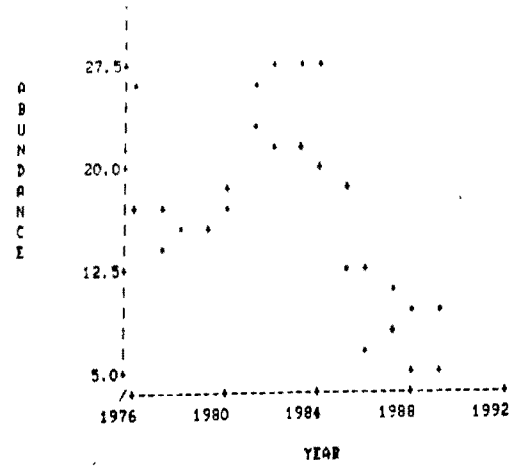
4T

AGE 10 PLOTS
SURVEY NO. PER TOW VS SPA NUMBERS



TREND IN STANDARDIZED RESIDUAL OVER TIME





SUMMARY OF DATA FROM PLOT

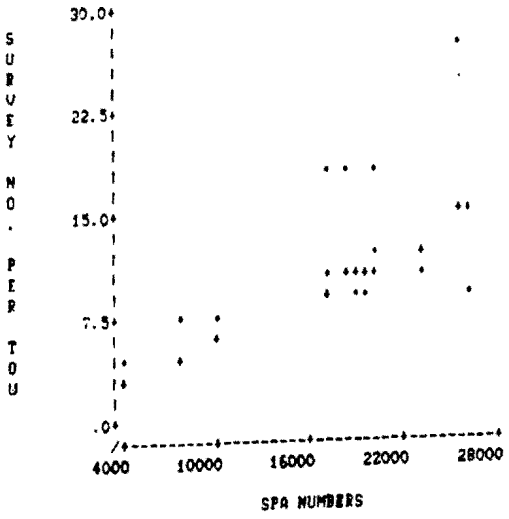
CARRIER VARIABLE: POPULATION NOS
RESPONSE VARIABLE(S): SURVEY - O:OBSERVED, +:PREDICTED

INDEX	CARRIER	O	+	RANK
1976	2.683E	26.51	17.48	1989
1977	2.62E4	14.65	17.07	1988
1978	2.449E	15.92	15.96	1987
1979	2.459E	32.86	16.02	1986
1980	2.901E	17.42	18.9	1978
1981	3.598E	25.68	23.44	1979
1982	4.22E4	21.5	27.49	1977
1983	3.385E	27.65	22.05	1976
1984	3.115E	28.18	20.29	1985
1985	2.853E	13.12	18.58	1980
1986	1.894E	6.66	12.34	1984
1987	1.273E	10.35	8.293	1983
1988	8703	9.65	5.669	1981
1989	8249	8.83	5.374	1982

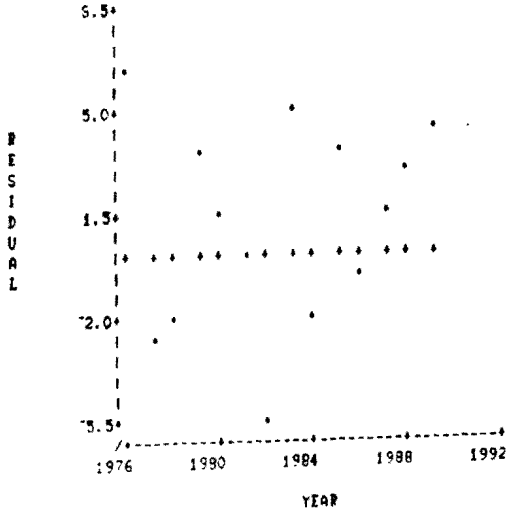
4T PLAICE TUNING MAY 1990

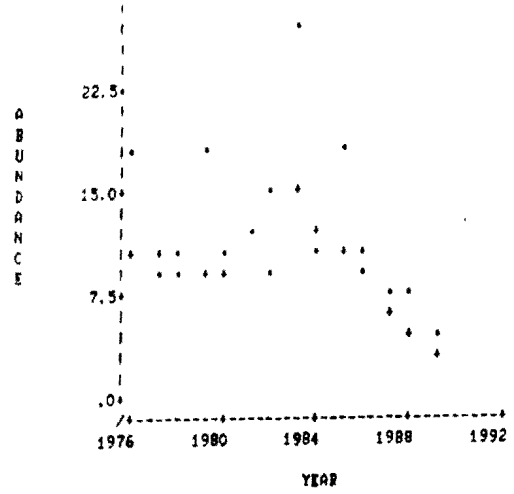
.4T

AGE 11 PLOTS
SURVEY NO. PER TOW VS SPA NUMBERS



TREND IN STANDARDIZED RESIDUAL OVER TIME





SUMMARY OF DATA FROM PLOT

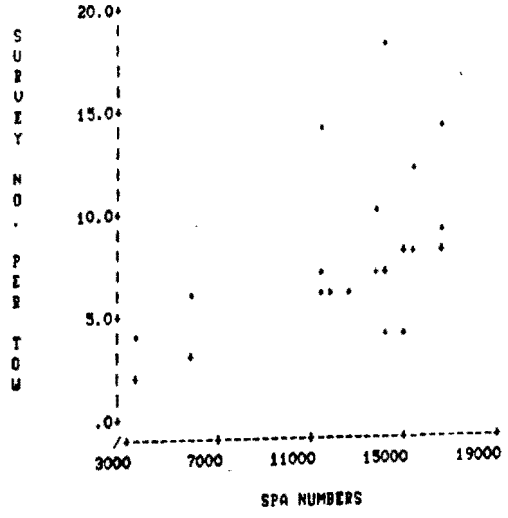
CARRIER VARIABLE: POPULATION NOS
RESPONSE VARIABLE(S): SURVEY - O:OBSERVED, +:PREDICTED

INDEX	CARRIER	O	+	RANK
1976	1.847E	17.88	10.2	1989
1977	1.914E	8.67	10.57	1988
1978	1.901E	8.39	10.5	1987
1979	1.734E	18.31	9.58	1980
1980	1.723E	10.55	9.517	1979
1981	2.047E	11.67	11.31	1976
1982	2.614E	9.06	14.44	1978
1983	2.583E	27.48	14.27	1977
1984	2.301E	10.46	12.71	1986
1985	2.017E	17.89	11.14	1985
1986	1.976E	8.9	10.92	1981
1987	1.026E	7.82	5.669	1984
1988	7589	6.99	4.192	1983
1989	4094	4.53	2.262	1982

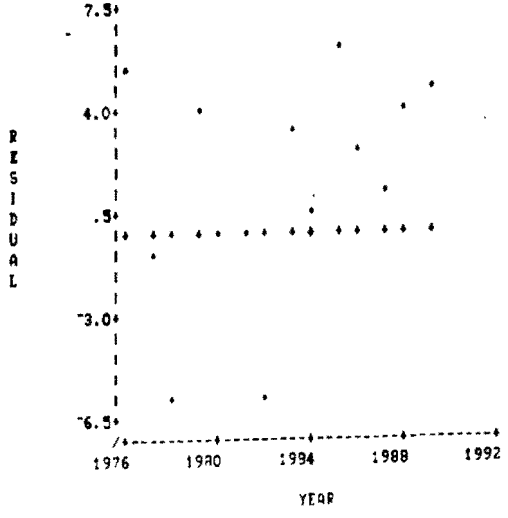
4T PLAICE TUNING MAY 1990

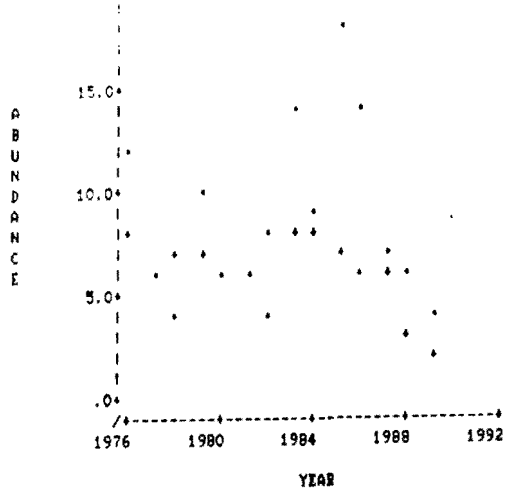
*4T

AGE 12 PLOTS
SURVEY NO. PER TOW VS SPA NUMBERS



TREND IN STANDARDIZED RESIDUAL OVER TIME





SUMMARY OF DATA FROM PLOT

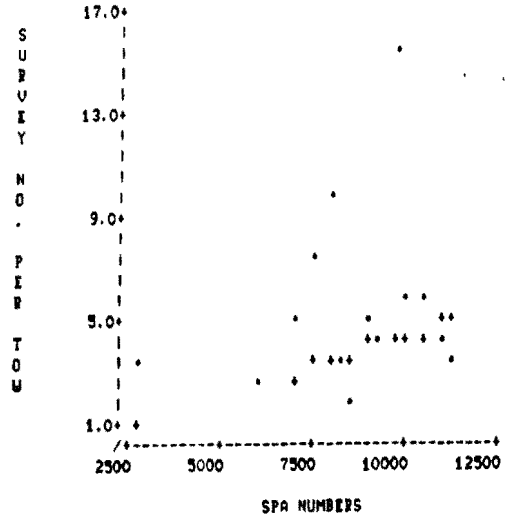
CARRIER VARIABLE: POPULATION NOS
RESPONSE VARIABLE(S): SURVEY - o:OBSERVED, +:PREDICTED

INDEX	CARRIER	*	*	RANK
1976	1.55E4	11.82	7.837	1989
1977	1.278E	5.93	6.464	1988
1978	1.418E	4.27	7.17	1987
1979	1.387E	9.89	7.014	1986
1980	1.157E	5.84	5.851	1980
1981	1.184E	5.65	5.986	1981
1982	1.492E	3.98	7.544	1977
1983	1.645E	14.04	8.318	1979
1984	1.647E	8.97	8.328	1978
1985	1.432E	18.47	7.241	1985
1986	1.153E	13.98	5.831	1982
1987	1.138E	7.3	5.752	1976
1988	5778	5.81	2.922	1983
1989	3528	4.23	1.784	1984

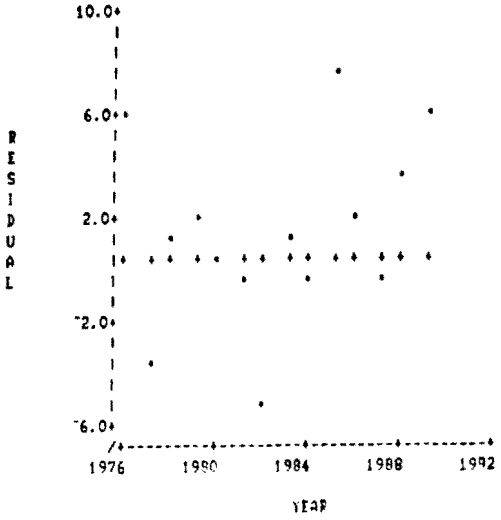
4T PLAICE TUNING MAY 1990

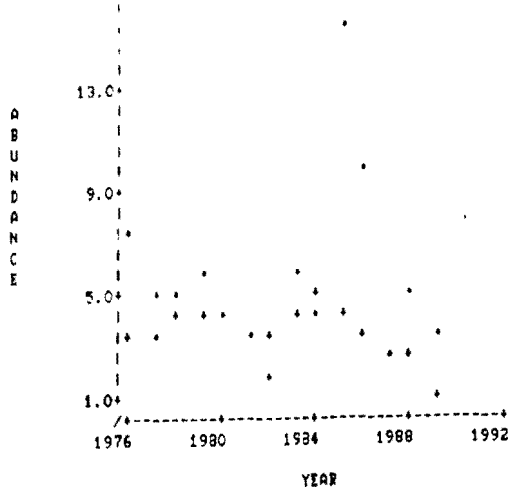
4T

AGE 13 PLOTS
SURVEY NO. PER TOU VS SPA NUMBERS



TREND IN STANDARDIZED RESIDUAL OVER TIME





SUMMARY OF DATA FROM PLOT

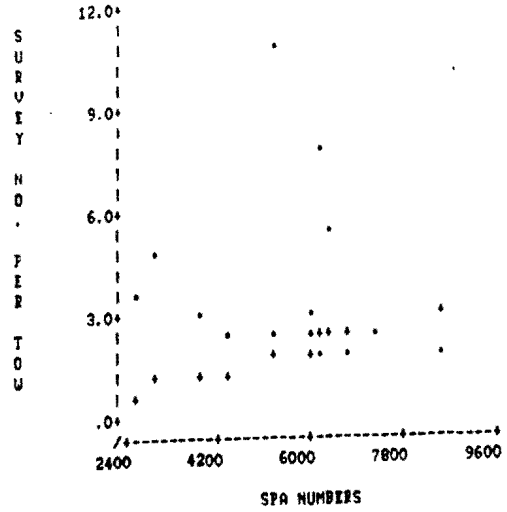
CARRIER VARIABLE: POPULATION NOS
RESPONSE VARIABLE(S): SURVEY - O:OBSERVED, +:PREDICTED

INDEX	CARRIER	O	+	RANK
1976	7381	7.03	3.107	1989
1977	1.129E	3.68	4.752	1987
1978	9058	4.67	3.813	1988
1979	1.053E	6.05	4.432	1976
1980	9282	4.1	3.907	1986
1981	6201	3.25	3.452	1981
1982	8506	2.05	3.58	1982
1983	1.006E	5.85	4.233	1978
1984	1.097E	4.23	4.618	1980
1985	9807	15.31	4.128	1985
1986	7990	9.54	3.363	1983
1987	6119	2.52	2.576	1979
1988	7076	5.39	2.978	1984
1989	2728	3.13	1.148	1977

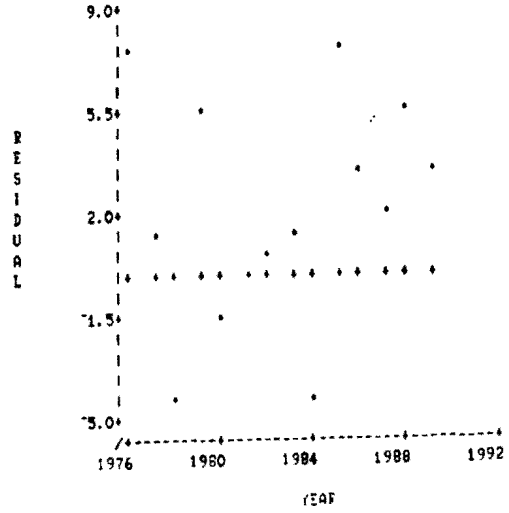
4T PLAICE TUNING MAY 1990

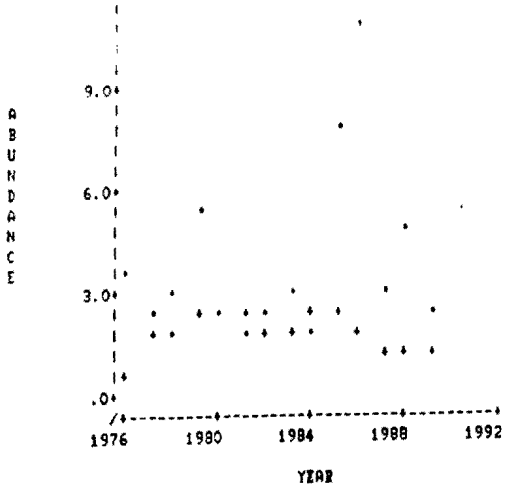
4T

AGE 14 PLOTS
SURVEY NO. PER TOW VS SPA NUMBERS



TREND IN STANDARDIZED RESIDUAL OVER TIME





SUMMARY OF DATA FROM PLOT

CARRIER VARIABLE: POPULATION NOS
RESPONSE VARIABLE(S): SURVEY - O:OBSERVED, +:PREDICTED

INDEX	CARRIER	*	*	RANK
1976	2491	3.65	0.855	1976
1977	5348	2.13	1.835	1988
1978	8534	1.53	2.929	1987
1979	6430	5.57	2.207	1989
1980	7179	2.15	2.464	1977
1981	6157	2.04	2.113	1986
1982	5988	2.21	2.055	1983
1983	5932	2.86	2.036	1982
1984	6671	1.6	2.29	1985
1985	6128	7.78	2.103	1981
1986	5363	11.04	1.841	1979
1987	3820	2.97	1.311	1984
1988	3012	4.51	1.034	1980
1989	4362	2.25	1.497	1978

)SAVE