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# Status of American plaice in NAFO Division 4T

by

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## ABSTRACT

Provisional landings of American plaice in NAFO Division 4T were 5,229 t in 1991 and 5,140 t in 1992. These are the lowest landings of plaice within the available time series beginning in 1965. An annual total allowable catch of 10,000 t has been adopted since 1977. Scottish seines dominate the fishery, contributing to over 50% of plaice landings since 1991. Mobile gear less than 45 ft were the most active component of the fleet in 1992, landing approximately 50% of the total plaice landings. Research surveys of 4T since 1971 indicate that plaice abundance was low in the early 1970s, peaked in 1977 at 1,046 plaice per tow and declined to fewer than 215 plaice per tow in 1987 and 1989. This abundance index has fluctuated at low levels of 201 to 379 plaice per tow since 1982. Research surveys indicated a reduction in fishable biomass (age 10+ plaice) from 21,800 t in 1991 to 12,600 t in 1992. A multiplicative analysis of survey catch at age estimated total mortality of plaice ages 7-19 at 0.54 over the period 1987-1992. This analysis also indicated a longterm pattern of yearclass strength, with an improving trend of yearclasses originating from the late 1980s. According to vessel observers, approximately 40% by weight of the commercial plaice catch was discarded at sea during 1991 and 1992. It appears that substantial improvement in the yield of this fishery would result from eliminating the capture of commercially undersized plaice. However, more extensive measures of the size and age composition of the discarded catches are required to accurately assess the effects of discarding.



## RÉSUMÉ

Selon les données provisoires, les débarquements de la plie canadienne dans la division 4T de l'OPANO ont atteint 5,229 t en 1991 et 5,140 t en 1992. Ces débarquements représentent les plus bas niveaux parmi les données disponibles depuis 1965. Une prise totale admissible de 10,000 t est adoptée pour ce stock depuis 1977. Les seines écossaises contribuent à plus de 50% des débarquements de la plie canadienne depuis 1991. En 1992, les engins mobiles, dont les bateaux sont inférieurs à 45 pieds de long, ont contribué à plus de 50% des débarquements de plie. Les relevés scientifiques, effectués en 4T depuis 1971, indiquent que l'abondance de plie était à un niveau bas au début des années 1970 et que l'abondance a augmenté à son maximum en 1977 à 1,046 plies par trait, diminuant par la suite jusqu'aux valeurs inférieures à 215 plies par trait en 1987 et 1989. L'indice d'abondance fluctue entre 201 et 379 plies par trait depuis 1982. Les relevés scientifiques indiquent une réduction dans la biomasse exploitable (plies de l'âge 10+) de 21,800 t en 1991 à 12,600 t en 1992. Une analyse multiplicative des prises à l'âge, provenant des relevés scientifiques, estime la mortalité totale à 0.54 pour les plies dont l'âge est 7-19 ans, durant la période de 1987-1992. Cette analyse indique un patron à long terme dans la force des classes d'âge, avec une amélioration dans la force des classes d'âge provenants de la fin des années 1980. Selon les observateurs en mer, environ 40% du poids de la capture commerciale de plie est rejetée en mer en 1991 et 1992. Il semblerait qu'en éliminant la capture des plies de taille non-commerciale, il en résulterait une nette augmentation dans le rendement de cette pêche. Il nous reste cependant à améliorer nos mesures de la composition de taille et de l'âge des rejets de la pêche commerciale afin d'évaluer plus précisément les effets du rejet en mer sur le rendement de pêche de la plie canadienne.

## INTRODUCTION

American plaice is a major component of demersal fish assemblages of the southern Gulf of St. Lawrence (NAFO Division 4T). Plaice have numerically dominated species collected during annual groundfish surveys of 4T since 1971 and are exceeded in total biomass only by Atlantic cod (Clay 1991). Powles (1964, 1965, 1969) provided much of the historical background on the biology and dynamics of American plaice in the Gulf of St. Lawrence. An important aspect of this fishery has been the widespread discarding of commercially undersized plaice, first noted by Jean (1963) and Powles (1969). The status of plaice in 4T was assessed annually from 1978 to 1990. In 1990, the Groundfish Subcommittee of CAFSAC recommended that plaice be assessed every three years, unless required otherwise by the fishing industry. In this document, we describe the status of 4T plaice over the 1991-92 period and longterm trends occurring in this stock.

### Description of the fishery

The American plaice fishery, once traditionally a by-catch fishery, was composed mainly of longlines in the 1930s and 1940s, but changed between 1947 and 1963 to an otter trawl-seine fishery (Powles 1969). The stock is now exploited by mobile gears principally, but also includes significant contributions from gillnets, longlines and handlines (Table 1). Scottish seines presently dominate the fishery, contributing to over 50% of the landings in 1991 and 1992.

Reported landings of American plaice in NAFO Division 4T since 1965 have varied from a maximum of 11,780 t in 1966 to a minimum of 5,140 in 1992 (Table 1). Although a precautionary quota of 10,000 t was introduced in 1977, reported landings have not exceeded that level since 1979. Since 1989, landings have declined below 6,000 t. Plaice landings for 1991 and 1992 are well below the mean of 8,275 t noted since 1965. A total allowable catch (TAC) of 10,000 t has been in place from 1977 to 1992.

Plaice landings for 1991 and 1992 are presented in Tables 1-3 based on provisional data supplied by the Statistics Branches of the Gulf, Quebec, Scotia-Fundy and Newfoundland regions of the Department of Fisheries and Oceans. The statistical unit areas of 4T are shown in Figure 1. The decline in landings of plaice in 4T has occurred throughout the Gulf, where landings in 4RST reached their lowest level in 1992 at 6,331 t, well below the longterm average of 10,274 t (Table 2). Table 2 illustrates the relative importance of plaice in Gulf-wide (4RST) flatfish fisheries and the general decline that has occurred. Combined flatfish landings in 4RST reached their minimum in 1991 and landings for most flatfish species were near or at their lowest recorded level in 1991 and 1992 (Table 2).

Within NAFO Division 4T, plaice are fished throughout the ice-free period, mainly during the months of May to November (Table 3). An analysis of landing statistics for 1991 indicates that plaice catches were concentrated in the eastern portion of 4T, in unit areas 4Tf and 4Tg (Figures 1 and 2). During 1991, 140 ports in the Quebec and Gulf regions reported landings of plaice caught in 4T. Two ports alone (Caraquet and Cheticamp) reported approximately 20% of the total landings. Figure 3 shows the distribution of the 10-most important landing points for 4T plaice. The mobile fleet of vessels <45 ft in length has increasingly dominated the allocation in recent years and contributed approximately 50% of the landings in 1992 (Table 4). Closures of the plaice fishery have not been imposed since 1985.

The plaice fishery in 4T was mostly a directed fishery during 1991 and 1992; however, the cod-directed fishery contributed significantly to plaice catches, particularly in the northeastern sector of 4T (Figures 4 and 5

illustrate pattern in 1991). Closures in the cod fishery to protect young cod can affect the plaice fishery by either causing fishermen to direct for plaice, or by inducing fishermen to stop fishing plaice because of the risk of catching small cod.

## METHODS

*Age determination*

Consistency in the reading of American plaice otoliths with past readers and over time was tested by procedures of calibration and error checking described by Chouinard et al (1987). A reference collection of plaice otoliths that has been read by previous readers was read at the outset of age determination and after every 1,500 otoliths aged. At each test, the interpretations of the current reader were compared to the standard and tested for bias. In 1992, nine tests were performed during the ageing of commercial and research collections of plaice otoliths. Agreement ranged between 81 and 90%. Only one test was significantly skewed, requiring the reader to reread the reference collection.

*Landings and weight at age*

Port sampling of commercial plaice catches was conducted throughout the months of active fishing (Table 5), providing similar coverage of length-frequency and age composition to that of previous years. Over 13,000 plaice were sexed and measured yearly in 1991 and 1992. Of these samples, over 1,600 plaice were aged yearly (Table 5).

Semi-annual age-length keys were prepared for the periods before and after July 31. Since the fishery extends normally from April to November (Table 3), the July-31 date divides the fishery into two equal periods. The semi-annual age-length keys grouped all gears together, assuming no gear effects. Length frequencies were computed semi-annually by major gear categories. Three main categories were considered: otter trawls and paired bottom trawls; Danish and Scottish seines; gillnets and longlines. Landings at age were calculated by applying the length frequencies associated with each gear category to the age-length key for the appropriate time period. The total landings at age were then adjusted for any unsampled gear in the fishery. Table 6 shows the sampling scheme and the sample sizes used.

Age-length keys and length frequencies were made for each sex separately. The landings at age for males, females and juveniles were then combined to give the overall landings at age for each gear type.

Length conversions to weight were based on yearly research vessel data. The weight of plaice in grams was log-transformed and regressed on log length (cm).

*Research Survey Data*

Research vessel surveys have been conducted every autumn since 1971 in the southern Gulf of St-Lawrence to provide an index of groundfish stock abundance. A stratified random survey design was adopted initially and has been maintained, except for the period 1984-1986 when randomly chosen fixed stations were used. The surveys are conducted in the month of September before groundfish stocks migrate from the Gulf.

Three research vessels have been used in surveys of 4T since 1971. The *E.E. Prince* was used from 1971 to 1985, when it was replaced by the *Lady Hammond*. The *Lady Hammond* was replaced by the *Alfred Needler* in 1992.

Following a comparative survey of the *E.E. Prince* and *Lady Hammond* in 1985, the CAFSAC Statistics, Sampling and Surveys Subcommittee recommended that mean catches of plaice by the *E.E. Prince* be corrected by a factor of 1.8 for equivalence with mean plaice catches by the *Lady Hammond*. A comparative survey of the *Lady Hammond* and the *Alfred Needler*, conducted in 1992, indicated no significant difference in catches between the two vessels.

Most sampling procedures in the southern Gulf groundfish surveys have remained relatively constant since 1971 and are documented in Hurlbut and Clay (1990). The length frequencies of American plaice have been sex-based, with the exception of the period 1984-1986, when sexes were combined. Biological sampling of plaice, including length, weight, sex, maturity and otolith collection, was conducted at a rate of one specimen per centimeter, sex and set. In 1991, the age-length key for research survey data was based on a collection of 5,366 plaice otoliths; in 1992, 4,934 plaice otoliths were read. Research survey analyses, including age-length keys, catch at age, and biomass, were performed with the program RVAN (Clay 1989).

The mean number at age of plaice per standard tow are presented for annual surveys since 1971. These values were then converted to a common scale of Z-scores for a visual evaluation of patterns in age-class strength. The 22-year series of mean catch per tow for each age class was normalized by log transformation (Shapiro-Wilkes W >0.88) and tested for skewness. Z-scores ($x-\mu/s$) were calculated for each catch at age relative to mean values over the 22-year time series.

Total mortalities at age (Z) were calculated for the 22-year series using catch curve analysis (Ricker 1975) with consecutive ages from a cohort. A multiplicative analysis of the survey mean catch at age was made to obtain estimates of mortality based on catch curves corrected for year-class variability and to provide an index of year-class strength. Similar analyses have been made by Landry (1986) for plaice and Sinclair and Chouinard (1992) for Atlantic cod. The multiplicative model examined the effects of age, year class, and the interactive effect of age and time period. Time periods were determined by dividing the series into approximate year quartiles: 1971-1975, 1976-1980, 1981-1986, and 1987-1992.

*Discarding*

The major difficulty in estimating commercial catch at age for American plaice is one of adequately quantifying the numbers of undersized plaice that are discarded at sea. Published studies of discarding rates for plaice in the southern Gulf estimate discarding of undersized plaice at 46-76% of catch by number (Cliche 1981, Chouinard and Metuzals 1985, Halliday et al 1989).

Tallman (1991b) proposed a method for estimating discarded plaice in 4T based on the use of length frequencies in annual research surveys and commercial data. The method, described in detail by Tallman and Forest-Gallant (1990) and Tallman (1991b), consists briefly of the following. The length frequencies by sex of plaice in survey strata were apportioned to unit areas of 4T by the proportions of the strata that make up each unit area and the proportion of the catch in each unit area. Sexed length frequencies were then calculated for the area of 4T that is fished by commercial vessels. A selectivity ogive for 130-mm mesh mobile gear (Clay et al 1984) was then applied to these data to generate length frequencies that are representative of length frequencies in the commercial fishery. The resulting length frequencies were then scaled to the landed catch by expanding the upper "undiscarded" portion of the theoretical length frequencies (plaice >40 cm) to match the numbers of plaice of that size range landed by the fishery. For plaice <40 cm, the difference between the numbers landed and the numbers scaled to the landed catch is the representative length frequency of discarded plaice in the fishery. Age-length keys based on research data were applied to

the length frequencies of discards to estimate the numbers of male and female plaice discarded annually by the fishery.

The validation of this method has been limited to comparison with empirical studies of plaice discarding aboard commercial vessels (Tallman 1991b). We compare estimated discards during 1991 and 1992 against data originating from the DFO Gulf Observer Program. This program, initiated in 1981, provides the most extensive database on discarding in Gulf fisheries. It operates with similar methodology to the Atlantic Observer Program, described by Kulka and Waldron (1983). During 1991, 3847 plaice catches in 4T were sampled and the weights of kept and discarded plaice measured. In 1992, 1262 4T plaice catches were observed.

*Partial Recruitment and YPR*

Partial recruitment was determined by a modified version of the technique described by Rivard (1984) where commercial catches are related to research-survey indices of catch at age. Two vectors of partial recruitment were estimated that correspond to reported commercial landings and to commercial catches including discarded plaice. Landed catch at age was divided by survey catch at age over a five-year period. The maximum age considered was 15 because beyond that age mean numbers at age in the survey data become small and more variable. A multiplicative model was used to standardize the catch ratio to age and year effects (Sinclair 1993). Partial recruitment vectors were determined by dividing the estimated catch ratio by the mean estimated value beyond age 11, assuming full recruitment by age 12.

Average weights at age, sexes combined, were determined from the commercial landings by combining the mean weights and estimated numbers for all gear and both sexes into a global average. For commercial catch data, the estimated length frequencies of each sex with discards were converted to weights using coefficients of the length-weight relationship established from research surveys. An age-length key was applied to apportion the length frequencies and weights to age classes. The resulting total numbers at age and total weights at age were used to estimate mean weight at age. Mean weights at age from the estimated catch were the means of five years of data.

Yield per recruit was estimated under three conditions to investigate the effect of discarding on the longterm potential of this stock: 1) yield was based on conditions in the present fishery where a portion of the catch is killed and discarded at sea; 2) yield was based on current estimated catches, with all plaice brought to port; 3) yield was based on current landed catches without any discarding at sea, i.e., the fishery partial recruitment was modified so that small undesirable plaice were not caught.

The following three equations were used to calculate 1) the change in population numbers between time periods, 2) fish deaths resulting from fishing and natural causes, and 3) landed weights of catches. To simplify subscripting, the equations represent the dynamics of one age group. The subscript a refers to years and the subscript f refers to the fishing scenarios.

$$N_{a+1}=N_a e^{-(M+FS_f)} \tag{1}$$

$$D_a=N_a(1-e^{-(M+FS_f)}) \tag{2}$$

$$L_a = W_f D_a \frac{FS_f}{M+FS_f} \quad (3)$$

where N is the population number;
M is the rate of natural mortality;
F is the rate of fully recruited fishing mortality;
S is the partial recruitment;
D is the number of fish dying;
L is the number of fish landed;
W is the mean weight at age;

As described above, two partial recruitment and weight-at-age vectors were used.

$S_l$ is the partial recruitment calculated with current landings;
$S_c$ is the partial recruitment calculated with current catches;
$W_l$ represents the weights at age of the current landings;
$W_c$ represents the weights at age of the current catch.

The following table summarizes the equations used in the three yield per recruit scenarios studied here.

| | Equation (PR) | | | |
|---|---|---|---|---|
| Scenario | 1 | 2 | 3 | W |
| 1. Status quo | $S_c$ | $S_c$ | $S_l$ | $W_l$ |
| 2. Land all catch | $S_c$ | $S_c$ | $S_c$ | $W_c$ |
| 3. Modify PR | $S_l$ | $S_l$ | $S_l$ | $W_l$ |

## RESULTS AND DISCUSSION

*Landings and weight at age*

Semi-annual landings at age by gear category are presented in Table 7 for 1991 and 1992. Nine-year-old plaice (yearclass 1982) dominated mobile gear in the second half of 1991 and were strong in the first half of 1992 in all gear categories.

The conversion of lengths to weights were based on the relation wt = $a \cdot len^b$ where

males (1991): a=0.005496; b=3.1321
females (1991): a=0.005143; b=3.1522
males (1992): a=0.006003; b=3.1004
females (1992): a=0.005416; b=3.1333

All of these relations were based on highly significant regressions ($P < 0.001$, $R^2 > 0.96$). Weights and lengths at age by sex (Tables 8 and 9) indicate declines in size between the first and second halves of 1991 and 1992. Tallman (1991a) suggested that this annual decline in size was due to movement of the fleet from the southeastern Gulf of St-Lawrence to the northwestern sector of the Gulf late in the fishing season. The growth rate of plaice in

the northwestern part of 4T is lower than that of plaice in southeastern 4T (Tallman 1991a), resulting in smaller fish of each age class caught in the second half of the year. An analysis of catch data during 1991 does not support this hypothesis, as there is no evident seasonal shift in landings from the southeast to the northwest (Figure 6). Tallman (1991a) also suggested that large plaice may move into winter refugia in the Laurentian Channel earlier in the year than smaller plaice. Clay (1991) and Powles (1969) showed that the Channel is used by American plaice during the colder months.

Combined landings at age are shown in Table 10 for 1976 to 1992. The total numbers landed increased sharply in 1992, due to the strong presence of age classes 7 to 11. The catch of 10-year-old plaice in 1992 was at the highest level for that age class recorded since 1980. The coefficients of variation of landings at age (Table 11) are similar to values recorded since 1989.

*Research survey data*

Mean numbers of plaice per standard tow peaked in 1977 at 1046 plaice per tow, declining thereafter to minima of less than 215 plaice per tow in 1987 and 1989 (Table 12). Mean numbers per tow increased in 1990 and 1991, but declined to 254 plaice per tow in 1992. The mean numbers at age expressed as Z-scores (Table 13) indicates the presence of strong age classes originating from the early 1970s moved through the series. The upper right half of the matrix is dominated by negative Z-scores. Age classes composing the 1992 catch were by majority over one standard deviation less than their 22-year averages.

Total mortalities at age, based on survey data, are presented in Table 14. These values have varied considerably from year to year but show high mortality for most age classes in 1991. The coefficients of variation for catch-at-age estimates from research surveys were in 1991 and 1992 among the lowest since the mid 1980s (Table 15). Plaice biomass, estimated from research surveys since 1987, is presented in Table 20. It shows considerable variation in that period in both the biomass of ages 1-9 and fishable biomass (age 10+), with a marked reduction in fishable biomass during 1992.

The multiplicative model of survey data accounted for 95% of the variation in mean catch (Table 16). The interactive term was significant, indicating a pattern of increasing mortality over the 22-year period (Figure 7). The following estimates of total mortality for the four time periods are based on regressions of predicted log catch at age.

| Period | Z ages 5-14 (SE) | Z ages 7-14 (SE) |
|---|---|---|
| 1971-75 | 0.29 (0.019) | 0.34 (0.011) |
| 1976-80 | 0.36 (0.014) | 0.39 (0.008) |
| 1981-86 | 0.40 (0.015) | 0.43 (0.015) |
| 1987-92 | 0.42 (0.013) | 0.50 (0.018) |

Predicted mean catch standardized by yearclass reveals a longterm pattern in yearclass strength with lowest values in the early 1960s, rising to a maximum in 1972, declining again to low values in the early 1980s, and rising again to 1987, the last yearclass included in the analysis (Figure 8). The 1982 yearclass, currently exploited in the commercial fishery, appears as a small increase during a period of weak yearclass strength.

The effects of variable yearclass strength and increasing mortality are reflected in growth data for female and male plaice (Table 18). The mean weight at age for both sexes reached minima during the late 1970s as abundant yearclasses appeared. Since 1979, the mean weights at age for several ageclasses >4 years have increased annually.

*Discarding*

Estimated discards, presented in Table 17, indicate maximum numbers of discarded plaice of combined sexes occurring between ages 7 and 10. Total numbers discarded fluctuated two-fold over the period 1989-1992. Discarded numbers at age from 1984 (Chouinard and Metuzals 1985) did not correspond to estimated values at ages under peak discarding (Figure 9); however, the study by Chouinard and Metuzals was based on 19 observations in a limited sector of 4T. Based on data from the DFO Gulf Observer Program, the proportion of the total weight of the plaice catch discarded during 1991 averaged 0.380 (unweighted mean, SE 0.005). The observed proportion of the weight discarded during 1992 averaged 0.393 (SE 0.008). These results do not support the large difference between the estimated total numbers discarded in 1991 and 1992 (Table 17). When the estimated numbers discarded at age for 1991 and 1992 are converted to weights (see following section for mean weights at age), the estimated proportions discarded far exceed observed discarding (71% estimated discarded in 1991; 57% in 1992).

The preceding comparison of estimated discards with observer data suggests that estimates based on the method outlined above overestimated discarding in 1991 and 1992, probably in the order of 20-30% of the weight of the catch. Further developments in the technique will be required before it can be utilized as a reliable estimate of the plaice catch.

*Partial Recruitment and YPR*

The multiplicative model that was used to standardize the ratio of commercial to research-survey catches at age accounted for 98 and 99% of the variability in catch ratios for landed catch and complete catch, respectively. Table 19 shows the partial recruitment vectors that resulted when the estimated catch ratio was divided by the mean estimated value beyond age 11, assuming full recruitment by age 12.

The yield per recruit was estimated at 0.028 kg under present conditions (first scenario), 0.066 kg when all fish were brought to port (second scenario), and 0.073 kg when only marketable sized plaice were caught (third scenario). When all fish were landed (scenario 2), $F_{0.1}$ was estimated at 0.43. Yield per recruit analyses produced $F_{0.1}$ at 0.37 when the fishery caught only marketable plaice. This analysis indicates a significant loss of potential yield, in the order of 60%, due to the estimated level of discarding in the plaice fishery.

The main purpose of this section was to illustrate a method of evaluating the extent to which discarding affects the yield to a fishery. In view of the results of the last section, where it was concluded that our estimates of discarding may be excessive, yield per recruit derived from these data should not be considered exactly representative of the 4T plaice fishery. Improved estimates of discarding, particularly the size and age composition of the discarded portion of the catch, are required for a more complete analysis of the effects of discarding on yield from the fishery. It appears, however, that a considerable improvement in the yield would result from eliminating the capture of commercially undersized plaice.

*Prognosis*

The abundance of the 4T plaice stock has declined since the late 1970s and has fluctuated at low levels since 1982. The research survey in 1992 indicated a decline in fishable biomass. The current exploitation rate for the stock appears to be between $F_{0.1}$ and twice $F_{0.1}$. Our analysis of research survey data suggests a longterm pattern in yearclass strength with improving recruitment composed of yearclasses of the late 1980s.

A high level of discarding persists in this fishery. Although improved estimates are required of the age composition of the discarded catch, it is likely that a substantial improvement in yield would result from eliminating the capture of commercially undersized plaice.

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Table 1. Nominal landings (t) of 4T American plaice from 1965-1992 by major gear types. Gear types: OTB=Otter trawls (unspecified), OTB1=Otter trawl-side, OTB2=Otter trawl stern, SNU= Seines, GN=Gillnets, LLS=Longlines, LH=Handlines)

| YEAR | OTB | OTB1 | OTB2 | SNU | GNS | LLS | LH | OTHER | TOTAL |
|---|---|---|---|---|---|---|---|---|---|
| 1965 | 7782 | 0 | 0 | 1854 | 388 | 212 | 0 | 149 | 10385 |
| 1966 | 0 | 8066 | 581 | 2322 | 375 | 2 | 0 | 434 | 11780 |
| 1967 | 0 | 7237 | 211 | 1151 | 326 | 117 | 50 | 259 | 9351 |
| 1968 | 0 | 7900 | 237 | 913 | 298 | 4 | 36 | 180 | 9568 |
| 1969 | 0 | 5609 | 425 | 1418 | 421 | 58 | 17 | 244 | 8192 |
| 1970 | 29 | 5793 | 477 | 2243 | 439 | 79 | 7 | 134 | 9201 |
| 1971 | 0 | 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 | 50 | 1075 | 2101 | 3140 | 831 | 664 | 67 | 136 | 8064 |
| 1988 | 15 | 540 | 2002 | 2842 | 957 | 484 | 33 | 116 | 6989 |
| 1989 | 14 | 495 | 1602 | 2489 | 501 | 212 | 386 | 18 | 5717 |
| 1990* | 0 | 733 | 1321 | 2469 | 658 | 323 | 10 | 100 | 5614 |
| 1991* | 0 | 146 | 1241 | 3063 | 508 | 103 | 24 | 144 | 5229 |
| 1992* | 0 | 173 | 1524 | 2712 | 538 | 73 | 16 | 104 | 5140 |
| MEAN | 453 | 2810 | 1027 | 2965 | 583 | 143 | 32 | 262 | 8275 |

* Provisional data

Table 2. Commercial flatfish nominal catches (t) in NAFO Division 4RST.

| YEAR | YELLOW TAIL | ATLANTIC HALIBUT | GREEN. HALIBUT | WITCH | WINTER FLOUNDER | AMER. PLAICE | UNSPEC. FLOUNDER | TOTAL |
|---|---|---|---|---|---|---|---|---|
| 1963 | 107 | 537 | 0 | 4250 | 3165 | 8470 | 0 | 16529 |
| 1964 | 65 | 615 | 0 | 3350 | 3014 | 8803 | 9 | 15856 |
| 1965 | 53 | 693 | 24 | 3608 | 4419 | 11098 | 5 | 19900 |
| 1966 | 157 | 612 | 365 | 3712 | 3136 | 12720 | 0 | 20702 |
| 1967 | 79 | 460 | 365 | 2714 | 2454 | 10497 | 24 | 16593 |
| 1968 | 12 | 444 | 689 | 3390 | 551 | 11932 | 0 | 17018 |
| 1969 | 268 | 510 | 802 | 4763 | 1710 | 10978 | 0 | 19031 |
| 1970 | 59 | 509 | 1112 | 4805 | 2694 | 13234 | 0 | 22413 |
| 1971 | 40 | 454 | 954 | 3821 | 2842 | 11770 | 0 | 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 | 0 | 22278 |
| 1987 | 409 | 261 | 11069 | 2609 | 2808 | 10409 | 0 | 27565 |
| 1988 | 215 | 238 | 7583 | 2530 | 1847 | 8980 | 0 | 21393 |
| 1989 | 55 | 291 | 5049 | 2347 | 2695 | 7520 | 0 | 17957 |
| 1990* | 87 | 503 | 2767 | 1769 | 2581 | 6940 | 0 | 14647 |
| 1991* | 84 | 382 | 2293 | 994 | 2862 | 6609 | 0 | 12360 |
| 1992* | 122 | 163 | 3413 | 977 | 2091 | 6331 | 0 | 13097 |
| MEAN | 94 | 330 | 2869 | 2916 | 2269 | 10274 | 590 | 19314 |

* Provisional data

Table 3. Preliminary landings (t) of 4T American plaice in 1991 and 1992 by gear and month. Values of 0 indicate landings of less than 50 kg; "-" indicates no landings. Gear types: OTB1= otter trawl-side, OTB2= otter trawl-stern, OTM2= midwater trawl-stern, PTB= bottom pair trawl, TXS= shrimp trawl, SDN= danish seine, SSC= scottish seine, SPR= pair seine, GNS= gillnet set LLS= set lines, LHP= handlines, LHB= handlines with bait, FPN= uncovered pound nets, UNK= unknown gear.

| | MONTH (1991) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GEAR | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | TOTAL |
| OTB1 | - | - | - | - | 11 | 14 | 25 | 36 | 34 | 21 | 5 | - | 146 |
| OTB2 | - | - | - | 25 | 118 | 113 | 211 | 208 | 279 | 225 | 62 | 0 | 1241 |
| OTM2 | - | - | - | 0 | - | - | - | - | - | - | - | - | 0 |
| PTB | - | - | - | - | 12 | 11 | 52 | 19 | 0 | 3 | - | - | 97 |
| TXS | - | - | - | 1 | 0 | 0 | 0 | 0 | 8 | 9 | 8 | - | 25 |
| SDN | - | - | - | 19 | 327 | 241 | 370 | 314 | 405 | 459 | 221 | 1 | 2355 |
| SSC | - | - | - | - | 69 | 92 | 185 | 67 | 19 | 61 | 136 | - | 629 |
| SPR | - | - | - | - | 1 | 15 | 30 | 19 | 7 | 5 | 0 | - | 79 |
| GNS | - | - | - | 1 | 80 | 232 | 72 | 46 | 59 | 19 | 1 | 0 | 508 |
| LLS | - | - | - | - | 1 | 9 | 33 | 33 | 14 | 9 | 4 | - | 103 |
| LHP | - | - | - | - | 0 | - | 0 | 0 | 0 | - | - | - | 0 |
| LHB | - | - | - | - | 6 | 1 | 1 | 7 | 7 | 1 | 1 | - | 24 |
| FPN | 1 | 1 | 0 | 0 | 2 | - | - | 1 | 10 | 3 | 2 | 1 | 21 |
| UNK | - | - | - | - | - | - | 0 | 0 | 0 | 0 | - | - | 0 |
| TOTAL | 1 | 1 | 0 | 46 | 625 | 727 | 980 | 751 | 843 | 815 | 438 | 2 | 5229 |

| | MONTH (1992) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GEAR | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | TOTAL |
| OTB1 | - | - | - | 2 | 21 | 18 | 19 | 32 | 13 | 54 | 13 | - | 173 |
| OTB2 | - | - | - | 3 | 224 | 169 | 267 | 295 | 266 | 202 | 97 | 0 | 1524 |
| OTM1 | - | - | - | - | - | - | - | 0 | - | - | 0 | - | 0 |
| OTM2 | - | - | - | - | - | - | - | - | - | - | 9 | - | 9 |
| PTB | - | - | - | - | 1 | 27 | 19 | 11 | 4 | 0 | 7 | 0 | 68 |
| PTM | - | - | - | - | - | - | - | - | - | - | 2 | - | 2 |
| TXS | - | - | - | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 19 | - | 22 |
| SDN | - | - | - | 1 | 391 | 396 | 190 | 167 | 160 | 378 | 233 | 0 | 1918 |
| SSC | - | - | - | - | 123 | 220 | 55 | 40 | 41 | 64 | 145 | - | 686 |
| SPR | - | - | - | - | 1 | 44 | 22 | 15 | 22 | 4 | 0 | - | 108 |
| GNS | - | - | - | 1 | 140 | 256 | 45 | 34 | 37 | 24 | 1 | - | 538 |
| LLS | - | - | - | 1 | 4 | 12 | 10 | 13 | 23 | 5 | 5 | - | 73 |
| LHP | - | - | - | - | - | 0 | 0 | 0 | 0 | 0 | - | - | 0 |
| LHB | - | - | - | - | 7 | 3 | 2 | 1 | 1 | 1 | 0 | - | 16 |
| FPN | 1 | 1 | - | - | - | - | 0 | 0 | 0 | 0 | - | - | 2 |
| UNK | - | - | - | - | - | - | 0 | - | 0 | - | - | - | 0 |
| TOTAL | 1 | 1 | 0 | 8 | 913 | 1145 | 630 | 608 | 568 | 734 | 533 | 1 | 5140 |

Table 4. Resource allocation scheme for American plaice in NAFO Division 4T, 1988-1991 (M.G. = mobile gear; F.G. = fixed gear).

| YEAR | GEAR | FINAL ALLOCATION (t) | CATCH (t) | CLOSURE |
|---|---|---|---|---|
| 1988 | M.G. (65-100) | 500 | 602 | none |
| | M.G. (<65) | 8000 | 5900 | none |
| | F.G. (<65) | 1500 | 149 | none |
| 1989 | M.G. (65-100) | 500 | 179 | none |
| | M.G. (45-65) | 3800 | 1509 | none |
| | M.G. (<45) | 4200 | 2460 | none |
| | F.G. (<65) | 1500 | 680 | none |
| 1990 | M.G. (65-100) | 500 | 368 | none |
| | M.G. (50-64) | 2990 | 1199 | none |
| | M.G. (45-49) | 810 | 271 | none |
| | M.G. (<45) | 4200 | 1829 | none |
| | F.G. (<65) | 1500 | 752 | none |
| 1991 | M.G. (65-100) | 500 | 347 | none |
| | M.G. (50-64) | 2480 | 992 | none |
| | M.G. (45-49) | 810 | 271 | none |
| | M.G. (<45) | 4200 | 1799 | none |
| | F.G. (<65) | 1480 | 730 | none |
| 1992 | M.G. (65-100) | 500 | 344 | none |
| | M.G. (50-64) | 2990 | 1058 | none |
| | M.G. (45-49) | 830 | 359 | none |
| | M.G. (<45) | 4200 | 2494 | none |
| | F.G. (<65) | 1480 | 624 | none |

Table 5. Numbers of American plaice measured and aged and the number of monthly samples. Upper table is 1991 samples.

| | | MAY | JUN | JUL | AUG | SEP | OCT | NOV | TOTAL |
|---|---|---|---|---|---|---|---|---|---|
| GNS | SIZED | 368 | 1013 | - | - | - | - | - | 1381 |
| | AGED | 54 | 110 | - | - | - | - | - | 164 |
| LLS | SIZED | - | - | 110 | - | 50 | - | - | 160 |
| | AGED | - | - | 44 | - | 36 | - | - | 80 |
| SNU | SIZED | 1155 | 1936 | 1916 | 721 | 206 | 1702 | 152 | 7788 |
| | AGED | 141 | 246 | 194 | 87 | 24 | 201 | 23 | 916 |
| OTB | SIZED | 2032 | 254 | 758 | 252 | - | 413 | 619 | 4328 |
| | AGED | 271 | 26 | 90 | 24 | - | 73 | 73 | 557 |
| SAMPLES | | 14 | 13 | 11 | 4 | 4 | 9 | 4 | 59 |

| | | MAY | JUN | JUL | AUG | SEP | OCT | NOV | TOTAL |
|---|---|---|---|---|---|---|---|---|---|
| GNS | SIZED | - | 516 | - | - | 20 | - | - | 536 |
| | AGED | - | 60 | - | - | 13 | - | - | 73 |
| LLS | SIZED | - | - | 79 | - | - | - | - | 79 |
| | AGED | - | - | 24 | - | - | - | - | 24 |
| SNU | SIZED | 634 | 1484 | 1844 | 583 | 706 | 968 | 808 | 7027 |
| | AGED | 72 | 159 | 242 | 78 | 75 | 131 | 117 | 874 |
| OTB | SIZED | 1084 | 1220 | 775 | 1253 | 258 | 770 | 251 | 5611 |
| | AGED | 170 | 158 | 82 | 126 | 24 | 90 | 27 | 677 |
| SAMPLES | | 7 | 15 | 12 | 8 | 5 | 8 | 5 | 60 |

Table 6. Input parameters and sample sizes of data used in calculation of commercial catch at age during 1991 and 1992. Table type refers to analysis: ALK = age-length key; LF = length frequency. Gear codes as in Tables 1 and 2.

| TABLE TYPE | GEARS | PERIOD (1991) | SAMPLE SIZE LENGTH | SAMPLE SIZE AGE | CATCH (t) |
|---|---|---|---|---|---|
| ALK | All gear | Jan-Jul | 9542 | 1176 | 2135 |
| ALK | All gear | Aug-Dec | 4115 | 541 | 2568 |
| LF | OTB1 OTB2 OTM2 PTB | Jan-Jul | 3044 | 0 | 483 |
| LF | SDN SSC SPR | Jan-Jul | 5007 | 0 | 1337 |
| LF | GNS LL LLS | Jan-Jul | 1491 | 0 | 312 |
| LF | OTB1 OTB2 OTM2 PTB | Aug-Dec | 1284 | 0 | 752 |
| LF | SDN SSC SPR | Aug-Dec | 2781 | 0 | 1600 |
| LF | GNS LL LLS | Aug-Dec | 50 | 0 | 185 |

| TABLE TYPE | GEARS | PERIOD (1992) | SAMPLE SIZE LENGTH | SAMPLE SIZE AGE | CATCH (t) |
|---|---|---|---|---|---|
| ALK | All gear | Jan-Jul | 7636 | 967 | 2698 |
| ALK | All gear | Aug-Dec | 5617 | 681 | 2443 |
| LF | OTB1 OTB2 OTM2 PTB | Jan-Jul | 3079 | 0 | 7700 |
| LF | SDN SSC SPR | Jan-Jul | 3962 | 0 | 1443 |
| LF | GNS LL LLS | Jan-Jul | 595 | 0 | 481 |
| LF | OTB1 OTB2 OTM2 PTB | Aug-Dec | 2532 | 0 | 1005 |
| LF | SDN SSC SPR | Aug-Dec | 3065 | 0 | 1269 |
| LF | GNS LL LLS | Aug-Dec | 20 | 0 | 146 |

Table 7. Landings at age ('000) of American plaice in 4T by gear and season during 1991 (upper) and 1992.

| | JAN-JUL | | | AUG-DEC | | | | |
|---|---|---|---|---|---|---|---|---|
| AGE | OTB | SNU | GNS/LL | OTB | SNU | GNS/LL | TOTAL CATCH | WEIGHTED CATCH |
| 1 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 | 0.00 |
| 2 | 0.573 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.57 | 0.58 |
| 3 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 | 0.00 |
| 4 | 0.000 | 0.000 | 0.000 | 5.941 | 0.000 | 0.000 | 5.94 | 5.98 |
| 5 | 2.532 | 4.008 | 0.095 | 41.276 | 22.387 | 2.336 | 72.63 | 73.16 |
| 6 | 16.127 | 25.351 | 2.325 | 122.219 | 61.061 | 1.425 | 228.51 | 230.18 |
| 7 | 75.784 | 132.980 | 13.007 | 217.249 | 133.866 | 7.064 | 579.95 | 584.18 |
| 8 | 84.482 | 174.839 | 25.074 | 162.689 | 180.194 | 19.608 | 646.89 | 651.61 |
| 9 | 178.378 | 362.653 | 52.190 | 414.913 | 371.468 | 40.238 | 1419.84 | 1430.20 |
| 10 | 111.106 | 254.027 | 47.162 | 239.921 | 231.228 | 32.902 | 916.35 | 923.04 |
| 11 | 119.875 | 308.851 | 68.506 | 157.628 | 173.439 | 20.232 | 848.53 | 854.73 |
| 12 | 90.053 | 218.873 | 57.354 | 122.055 | 254.846 | 37.518 | 780.70 | 786.40 |
| 13 | 74.059 | 180.757 | 49.161 | 65.811 | 114.065 | 26.159 | 510.01 | 513.74 |
| 14 | 42.174 | 106.455 | 36.347 | 49.050 | 104.274 | 20.474 | 358.77 | 361.39 |
| 15 | 28.835 | 68.732 | 24.119 | 38.384 | 83.302 | 11.227 | 254.60 | 256.46 |
| 16 | 31.310 | 81.757 | 26.290 | 20.312 | 98.167 | 10.183 | 268.02 | 269.98 |
| 17 | 34.112 | 91.058 | 28.309 | 19.711 | 90.132 | 10.052 | 273.37 | 275.37 |
| 18 | 14.376 | 40.175 | 11.279 | 11.494 | 73.315 | 5.890 | 156.53 | 157.67 |
| 19 | 13.112 | 38.206 | 10.036 | 14.482 | 91.478 | 9.917 | 177.23 | 178.52 |
| 20 | 10.928 | 43.361 | 8.632 | 20.716 | 104.454 | 5.725 | 193.82 | 195.23 |
| 21 | 5.272 | 17.834 | 4.788 | 6.429 | 21.446 | 2.202 | 57.97 | 58.39 |
| 22 | 3.985 | 16.968 | 1.680 | 0.472 | 25.701 | 4.587 | 53.39 | 53.78 |
| 23 | 1.571 | 6.540 | 0.852 | 5.942 | 6.395 | 1.889 | 23.19 | 23.36 |
| 24 | 0.748 | 2.700 | 0.689 | 1.581 | 13.757 | 1.330 | 20.81 | 20.96 |
| 25 | 0.009 | 0.899 | 0.065 | 0.000 | 2.993 | 0.000 | 3.97 | 3.99 |
| 26 | 0.000 | 0.000 | 0.000 | 0.034 | 10.030 | 1.330 | 11.39 | 11.48 |

| | JAN-JUL | | | AUG-DEC | | | | |
|---|---|---|---|---|---|---|---|---|
| AGE | OTB | SNU | GNS/LL | OTB | SNU | GNS/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 | 0.384 | 0.000 | 0.000 | 0.38 | 0.39 |
| 4 | 4.701 | 6.698 | 1.205 | 1.335 | 0.771 | 1.205 | 15.92 | 16.00 |
| 5 | 2.378 | 5.544 | 1.763 | 16.964 | 15.335 | 12.009 | 53.99 | 54.27 |
| 6 | 41.449 | 17.830 | 3.349 | 194.947 | 163.055 | 32.393 | 453.02 | 455.33 |
| 7 | 157.997 | 115.159 | 18.799 | 289.255 | 263.839 | 89.023 | 934.07 | 938.84 |
| 8 | 314.087 | 280.856 | 47.923 | 419.256 | 375.026 | 82.943 | 1520.09 | 1527.84 |
| 9 | 242.704 | 212.057 | 41.965 | 378.294 | 364.750 | 48.012 | 1287.78 | 1294.35 |
| 10 | 426.745 | 554.946 | 120.123 | 413.914 | 363.700 | 68.365 | 1947.79 | 1957.73 |
| 11 | 224.776 | 284.713 | 78.115 | 264.409 | 257.966 | 38.649 | 1148.63 | 1154.49 |
| 12 | 99.790 | 167.540 | 57.484 | 205.119 | 259.665 | 42.335 | 831.93 | 836.18 |
| 13 | 78.505 | 131.522 | 52.430 | 29.518 | 73.134 | 6.789 | 371.90 | 373.79 |
| 14 | 72.088 | 125.458 | 49.442 | 55.452 | 75.131 | 3.314 | 380.89 | 382.83 |
| 15 | 34.384 | 82.797 | 34.440 | 46.760 | 72.308 | 2.891 | 273.58 | 274.98 |
| 16 | 35.239 | 79.892 | 26.597 | 29.478 | 69.163 | 2.109 | 242.48 | 243.71 |
| 17 | 15.025 | 45.380 | 19.342 | 6.803 | 25.316 | 1.205 | 113.07 | 113.65 |
| 18 | 14.015 | 51.106 | 21.152 | 14.235 | 42.297 | 2.409 | 145.21 | 145.95 |
| 19 | 12.440 | 52.571 | 16.347 | 1.407 | 14.571 | 0.000 | 97.34 | 97.83 |
| 20 | 9.482 | 60.130 | 20.724 | 6.434 | 15.124 | 0.000 | 111.89 | 112.46 |
| 21 | 6.194 | 30.906 | 15.444 | 2.144 | 10.531 | 0.000 | 65.22 | 65.55 |
| 22 | 1.813 | 6.677 | 6.987 | 0.477 | 2.589 | 0.000 | 18.54 | 18.64 |
| 23 | 0.347 | 4.435 | 0.745 | 0.000 | 0.000 | 0.000 | 5.53 | 5.56 |
| 24 | 0.162 | 2.242 | 1.804 | 0.000 | 0.000 | 0.000 | 4.21 | 4.23 |
| 25 | 0.916 | 4.235 | 2.792 | 0.000 | 1.323 | 0.000 | 9.27 | 9.31 |
| 26 | 0.247 | 1.630 | 2.082 | 0.000 | 0.000 | 0.000 | 3.96 | 3.98 |
| 27 | 0.285 | 1.440 | 0.646 | 0.000 | 0.000 | 0.000 | 2.37 | 2.38 |
| 28 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 | 0.00 |
| 29 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 | 0.00 |
| 30 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 | 0.00 |

Table 8. Average weight at age (kg) of 4T American plaice from main commercial gear types during 1991 and 1992.

| | MALES | | | | | | FEMALES | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | JAN-JUL | | | AUG-DEC | | | JAN-JUL | | | AUG-DEC | | |
| AGE | OTB | SNU | GNS/LLS | OTB | SNU | GNS/LLS | OTB | SNU | GNS/LLS | OTB | SNU | GNS/LLS |
| 1 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2 | 0.131 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 3 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 4 | 0.000 | 0.000 | 0.000 | 0.101 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 5 | 0.065 | 0.000 | 0.000 | 0.156 | 0.170 | 0.000 | 0.260 | 0.259 | 0.271 | 0.284 | 0.384 | 0.439 |
| 6 | 0.167 | 0.172 | 0.000 | 0.166 | 0.210 | 0.000 | 0.311 | 0.361 | 0.365 | 0.296 | 0.311 | 0.345 |
| 7 | 0.287 | 0.306 | 0.430 | 0.273 | 0.287 | 0.000 | 0.330 | 0.371 | 0.435 | 0.330 | 0.378 | 0.506 |
| 8 | 0.268 | 0.288 | 0.366 | 0.260 | 0.253 | 0.412 | 0.392 | 0.432 | 0.474 | 0.396 | 0.446 | 0.475 |
| 9 | 0.285 | 0.300 | 0.380 | 0.270 | 0.317 | 0.571 | 0.389 | 0.431 | 0.472 | 0.388 | 0.443 | 0.472 |
| 10 | 0.305 | 0.325 | 0.449 | 0.302 | 0.321 | 0.481 | 0.450 | 0.484 | 0.522 | 0.410 | 0.477 | 0.534 |
| 11 | 0.335 | 0.355 | 0.465 | 0.258 | 0.305 | 0.418 | 0.501 | 0.532 | 0.561 | 0.461 | 0.576 | 0.585 |
| 12 | 0.356 | 0.379 | 0.460 | 0.322 | 0.300 | 0.458 | 0.564 | 0.602 | 0.636 | 0.671 | 0.697 | 0.582 |
| 13 | 0.351 | 0.367 | 0.517 | 0.331 | 0.352 | 0.475 | 0.622 | 0.666 | 0.679 | 0.704 | 0.758 | 0.711 |
| 14 | 0.316 | 0.350 | 0.678 | 0.305 | 0.355 | 0.527 | 0.743 | 0.786 | 0.775 | 0.691 | 0.746 | 0.640 |
| 15 | 0.390 | 0.383 | 0.549 | 0.284 | 0.329 | 0.631 | 0.836 | 0.915 | 0.818 | 0.852 | 0.909 | 0.741 |
| 16 | 0.392 | 0.401 | 0.504 | 0.597 | 0.685 | 0.585 | 0.888 | 1.004 | 0.893 | 1.095 | 1.228 | 1.080 |
| 17 | 0.367 | 0.346 | 0.612 | 0.295 | 0.402 | 0.538 | 0.924 | 1.015 | 0.898 | 1.133 | 1.167 | 1.203 |
| 18 | 0.314 | 0.314 | 0.000 | 0.000 | 0.000 | 0.000 | 1.165 | 1.284 | 1.011 | 0.874 | 1.074 | 1.030 |
| 19 | 0.472 | 0.479 | 0.901 | 0.000 | 0.000 | 0.000 | 1.031 | 1.124 | 0.932 | 1.127 | 1.218 | 1.519 |
| 20 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1.197 | 1.542 | 1.087 | 1.317 | 1.426 | 1.532 |
| 21 | 0.000 | 0.000 | 0.000 | 0.314 | 0.314 | 0.000 | 1.236 | 1.466 | 1.136 | 1.143 | 1.470 | 1.667 |
| 22 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1.576 | 1.821 | 1.476 | 0.897 | 1.477 | 1.528 |
| 23 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1.615 | 1.781 | 1.769 | 1.762 | 1.805 | 2.072 |
| 24 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1.511 | 1.539 | 1.789 | 1.033 | 1.440 | 1.401 |
| 25 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1.862 | 2.081 | 1.862 | 0.000 | 2.084 | 0.000 |
| 26 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1.401 | 1.401 | 1.401 |
| 1992: | | | | | | | | | | | | |
| 1 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 3 | 0.000 | 0.000 | 0.000 | 0.065 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 4 | 0.000 | 0.000 | 0.000 | 0.401 | 0.401 | 0.401 | 0.407 | 0.407 | 0.407 | 0.000 | 0.000 | 0.000 |
| 5 | 0.000 | 0.076 | 0.000 | 0.290 | 0.232 | 0.287 | 0.524 | 0.524 | 0.524 | 0.255 | 0.249 | 0.243 |
| 6 | 0.226 | 0.442 | 0.475 | 0.282 | 0.271 | 0.270 | 0.306 | 0.341 | 0.482 | 0.369 | 0.361 | 0.304 |
| 7 | 0.290 | 0.339 | 0.416 | 0.268 | 0.257 | 0.254 | 0.338 | 0.406 | 0.478 | 0.347 | 0.355 | 0.302 |
| 8 | 0.287 | 0.326 | 0.397 | 0.322 | 0.313 | 0.318 | 0.361 | 0.423 | 0.479 | 0.388 | 0.415 | 0.320 |
| 9 | 0.309 | 0.356 | 0.436 | 0.319 | 0.323 | 0.312 | 0.377 | 0.442 | 0.514 | 0.446 | 0.483 | 0.333 |
| 10 | 0.312 | 0.360 | 0.474 | 0.316 | 0.316 | 0.291 | 0.422 | 0.459 | 0.517 | 0.444 | 0.478 | 0.431 |
| 11 | 0.306 | 0.354 | 0.518 | 0.339 | 0.326 | 0.336 | 0.477 | 0.523 | 0.581 | 0.467 | 0.511 | 0.448 |
| 12 | 0.339 | 0.389 | 0.626 | 0.340 | 0.357 | 0.378 | 0.562 | 0.612 | 0.663 | 0.542 | 0.622 | 0.588 |
| 13 | 0.366 | 0.412 | 0.538 | 0.374 | 0.352 | 0.346 | 0.591 | 0.643 | 0.674 | 0.783 | 0.836 | 0.711 |
| 14 | 0.356 | 0.386 | 0.582 | 0.367 | 0.378 | 0.312 | 0.685 | 0.752 | 0.752 | 0.578 | 0.663 | 0.373 |
| 15 | 0.425 | 0.460 | 0.547 | 0.442 | 0.465 | 0.437 | 0.754 | 0.907 | 0.884 | 0.573 | 0.795 | 0.000 |
| 16 | 0.395 | 0.379 | 0.406 | 0.340 | 0.351 | 0.228 | 1.067 | 1.180 | 1.064 | 0.652 | 0.894 | 0.444 |
| 17 | 0.401 | 0.541 | 0.479 | 0.401 | 0.425 | 0.401 | 0.926 | 1.150 | 1.143 | 0.949 | 1.111 | 0.000 |
| 18 | 0.774 | 0.722 | 0.686 | 0.000 | 0.601 | 0.000 | 0.941 | 1.071 | 1.144 | 0.929 | 1.009 | 0.711 |
| 19 | 0.359 | 0.395 | 0.514 | 0.000 | 0.000 | 0.000 | 0.953 | 1.276 | 1.226 | 1.191 | 1.406 | 0.000 |
| 20 | 0.000 | 1.380 | 0.000 | 0.000 | 0.000 | 0.000 | 1.501 | 1.461 | 1.622 | 1.142 | 0.940 | 0.000 |
| 21 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1.300 | 1.371 | 1.614 | 1.130 | 1.340 | 0.000 |
| 22 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 2.017 | 1.763 | 1.970 | 1.140 | 1.484 | 0.000 |
| 23 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1.486 | 1.622 | 1.459 | 0.000 | 0.000 | 0.000 |
| 24 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 2.019 | 2.219 | 2.044 | 0.000 | 0.000 | 0.000 |
| 25 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1.328 | 1.431 | 1.494 | 0.000 | 1.719 | 0.000 |
| 26 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 2.010 | 2.092 | 2.027 | 0.000 | 0.000 | 0.000 |
| 27 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1.290 | 1.290 | 1.290 | 0.000 | 0.000 | 0.000 |
| 28 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 29 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 30 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

Table 9. Average length (cm) at age of American plaice in NAFO Division 4T by gear and season during 1991 (upper panel) and 1992.

| | MALES | | | | | | FEMALES | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | JAN-JUL | | | AUG-DEC | | | JAN-JUL | | | AUG-DEC | | |
| AGE | OTB | SNU | GNS/LLS | OTB | SNU | GNS/LLS | OTB | SNU | GNS/LLS | OTB | SNU | GNS/LLS |
| 2 | 25.00 | - | - | - | - | - | - | - | - | - | - | - |
| 3 | - | - | - | - | - | - | - | - | - | - | - | - |
| 4 | - | - | - | 23.00 | - | - | - | - | - | - | - | - |
| 5 | 20.00 | - | - | 26.40 | 27.12 | - | 31.00 | 30.37 | 31.46 | 31.34 | 34.82 | 36.66 |
| 6 | 26.85 | 27.20 | - | 26.72 | 29.00 | - | 32.65 | 33.69 | 34.36 | 32.28 | 32.77 | 33.93 |
| 7 | 31.89 | 32.47 | 36.38 | 31.53 | 32.01 | - | 33.28 | 33.93 | 36.29 | 33.36 | 34.62 | 37.89 |
| 8 | 31.13 | 31.85 | 34.46 | 30.99 | 30.68 | 36.00 | 35.11 | 35.66 | 37.35 | 35.30 | 36.68 | 37.50 |
| 9 | 31.83 | 32.34 | 34.82 | 31.31 | 32.98 | 39.68 | 35.06 | 35.64 | 37.24 | 35.08 | 36.55 | 37.35 |
| 10 | 32.51 | 33.15 | 36.82 | 32.54 | 33.19 | 37.63 | 36.72 | 37.01 | 38.50 | 35.69 | 37.34 | 38.78 |
| 11 | 33.49 | 34.17 | 37.28 | 30.71 | 32.52 | 36.12 | 37.94 | 38.10 | 39.39 | 36.83 | 39.54 | 40.00 |
| 12 | 34.12 | 34.85 | 37.19 | 32.99 | 32.19 | 37.18 | 39.25 | 39.44 | 40.93 | 41.27 | 41.92 | 39.97 |
| 13 | 33.92 | 34.49 | 38.41 | 33.42 | 34.12 | 37.66 | 40.38 | 40.54 | 41.71 | 42.37 | 43.29 | 42.56 |
| 14 | 32.84 | 33.86 | 41.25 | 32.55 | 34.08 | 38.90 | 42.79 | 42.81 | 43.56 | 41.49 | 42.89 | 41.15 |
| 15 | 35.07 | 34.98 | 39.17 | 31.89 | 33.20 | 41.11 | 44.49 | 45.00 | 44.30 | 44.92 | 45.90 | 43.04 |
| 16 | 35.21 | 35.48 | 38.30 | 40.52 | 42.16 | 40.26 | 45.19 | 46.19 | 45.49 | 48.59 | 50.41 | 48.31 |
| 17 | 34.28 | 33.82 | 40.66 | 31.95 | 34.91 | 39.13 | 45.83 | 46.37 | 45.61 | 49.09 | 49.69 | 50.04 |
| 18 | 33.00 | 33.00 | - | - | - | - | 49.42 | 50.14 | 47.35 | 45.06 | 48.01 | 47.05 |
| 19 | 37.49 | 37.46 | 45.65 | - | - | - | 47.12 | 47.57 | 45.99 | 48.90 | 50.17 | 53.52 |
| 20 | - | - | - | - | - | - | 49.77 | 52.91 | 48.26 | 51.79 | 53.05 | 54.31 |
| 21 | - | - | - | 33.00 | 33.00 | - | 50.49 | 52.27 | 49.12 | 49.60 | 53.60 | 56.00 |
| 22 | - | - | - | - | - | - | 54.89 | 56.40 | 53.68 | 46.00 | 53.63 | 54.28 |
| 23 | - | - | - | - | - | - | 55.36 | 56.07 | 56.63 | 57.00 | 57.40 | 60.00 |
| 24 | - | - | - | - | - | - | 54.17 | 53.57 | 56.74 | 48.11 | 53.07 | 53.00 |
| 25 | - | - | - | - | - | - | 58.00 | 58.90 | 58.00 | - | 60.00 | - |
| 26 | - | - | - | - | - | - | - | - | - | 53.00 | 53.00 | 53.00 |
| 1992: | | | | | | | | | | | | |
| 3 | - | - | - | 20.00 | - | - | - | - | - | - | - | - |
| 4 | - | - | - | 36.00 | 36.00 | 36.00 | 36.00 | 36.00 | 36.00 | - | - | - |
| 5 | - | 21.00 | - | 32.21 | 29.60 | 32.14 | 39.00 | 39.00 | 39.00 | 30.97 | 30.57 | 30.51 |
| 6 | 28.85 | 36.86 | 38.00 | 31.85 | 31.48 | 31.44 | 32.76 | 33.78 | 37.30 | 34.75 | 34.47 | 32.71 |
| 7 | 32.28 | 33.92 | 36.03 | 31.51 | 31.08 | 31.01 | 33.69 | 35.64 | 37.56 | 34.03 | 34.23 | 32.65 |
| 8 | 32.19 | 33.52 | 35.69 | 33.40 | 33.05 | 33.19 | 34.44 | 36.25 | 37.69 | 35.21 | 35.84 | 33.16 |
| 9 | 32.93 | 34.49 | 36.56 | 33.38 | 33.45 | 33.04 | 34.87 | 36.74 | 38.54 | 36.81 | 37.68 | 33.61 |
| 10 | 33.04 | 34.60 | 37.46 | 33.19 | 33.13 | 32.25 | 36.22 | 37.19 | 38.61 | 36.83 | 37.57 | 36.23 |
| 11 | 32.86 | 34.40 | 38.78 | 33.97 | 33.56 | 33.78 | 37.57 | 38.68 | 40.02 | 37.38 | 38.40 | 36.77 |
| 12 | 33.82 | 35.45 | 41.14 | 34.04 | 34.48 | 35.14 | 39.52 | 40.56 | 41.70 | 39.14 | 40.84 | 40.07 |
| 13 | 34.68 | 36.15 | 39.25 | 35.01 | 34.34 | 34.20 | 40.14 | 41.19 | 42.02 | 44.19 | 45.12 | 43.00 |
| 14 | 34.46 | 35.38 | 40.23 | 34.84 | 34.98 | 32.91 | 41.99 | 43.11 | 43.35 | 39.80 | 41.53 | 35.00 |
| 15 | 36.27 | 37.33 | 39.47 | 36.89 | 37.64 | 37.00 | 43.39 | 45.80 | 45.54 | 39.70 | 43.67 | - |
| 16 | 35.34 | 35.20 | 36.05 | 33.94 | 34.03 | 30.00 | 47.92 | 49.80 | 48.22 | 41.32 | 45.54 | 37.00 |
| 17 | 35.41 | 38.84 | 38.03 | 36.00 | 36.58 | 36.00 | 46.15 | 49.41 | 49.28 | 47.04 | 49.19 | - |
| 18 | 44.17 | 43.11 | 42.50 | - | 41.00 | - | 46.35 | 48.46 | 49.22 | 46.55 | 47.75 | 43.00 |
| 19 | 34.64 | 35.64 | 39.00 | - | - | - | 46.19 | 50.91 | 50.42 | 50.54 | 53.06 | - |
| 20 | - | 53.60 | - | - | - | - | 54.30 | 53.99 | 55.68 | 48.65 | 46.19 | - |
| 21 | - | - | - | - | - | - | 51.74 | 52.59 | 55.22 | 49.76 | 51.99 | - |
| 22 | - | - | - | - | - | - | 59.67 | 57.23 | 59.29 | 50.00 | 53.85 | - |
| 23 | - | - | - | - | - | - | 54.10 | 55.65 | 53.80 | - | - | - |
| 24 | - | - | - | - | - | - | 60.00 | 61.74 | 60.23 | - | - | - |
| 25 | - | - | - | - | - | - | 52.31 | 53.59 | 54.31 | - | 57.00 | - |
| 26 | - | - | - | - | - | - | 59.84 | 60.44 | 60.00 | - | - | - |
| 27 | - | - | - | - | - | - | 52.00 | 52.00 | 52.00 | - | - | - |
| 28 | - | - | - | - | - | - | - | - | - | - | - | - |
| 29 | - | - | - | - | - | - | - | - | - | - | - | - |
| 30 | - | - | - | - | - | - | - | - | - | - | - | - |

Table 10. Estimated annual landings at age ('000) of 4T American plaice since 1976.

| AGE | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0 | 0 | 0 | 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 | 0 | 1 | 0 |
| 3 | 0 | 0 | 0 | 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 | 345 | 6 | 16 |
| 5 | 37 | 99 | 242 | 0 | 0 | 0 | 0 | 128 | 195 | 89 | 25 | 48 | 60 | 93 | 152 | 73 | 54 |
| 6 | 457 | 601 | 776 | 473 | 81 | 41 | 25 | 177 | 356 | 92 | 397 | 139 | 232 | 381 | 440 | 230 | 455 |
| 7 | 1380 | 2101 | 2002 | 1202 | 615 | 190 | 46 | 286 | 798 | 464 | 769 | 483 | 234 | 921 | 739 | 584 | 939 |
| 8 | 2371 | 2253 | 3837 | 4682 | 1129 | 461 | 378 | 417 | 782 | 680 | 1322 | 527 | 484 | 1119 | 1603 | 652 | 1528 |
| 9 | 2142 | 1884 | 2671 | 5723 | 2771 | 717 | 1061 | 529 | 960 | 728 | 1349 | 574 | 768 | 1531 | 1374 | 1430 | 1294 |
| 10 | 2400 | 1625 | 2612 | 3926 | 2640 | 1564 | 1682 | 843 | 1557 | 1161 | 1193 | 794 | 739 | 1018 | 1409 | 923 | 1958 |
| 11 | 2036 | 1295 | 2144 | 2379 | 2279 | 1190 | 1482 | 1107 | 1823 | 1664 | 1505 | 784 | 822 | 828 | 913 | 855 | 1154 |
| 12 | 2818 | 1706 | 1470 | 1534 | 2722 | 1417 | 1489 | 1454 | 1628 | 2098 | 1677 | 868 | 980 | 669 | 627 | 786 | 836 |
| 13 | 1466 | 902 | 1383 | 1051 | 2322 | 944 | 1027 | 1476 | 1009 | 1769 | 1572 | 1094 | 800 | 577 | 615 | 514 | 374 |
| 14 | 796 | 594 | 720 | 988 | 1663 | 1314 | 735 | 873 | 1299 | 1560 | 1016 | 984 | 968 | 443 | 426 | 361 | 383 |
| 15 | 397 | 289 | 542 | 309 | 1586 | 2047 | 413 | 600 | 883 | 1112 | 798 | 958 | 828 | 391 | 372 | 256 | 275 |
| 16 | 407 | 231 | 144 | 209 | 713 | 949 | 324 | 468 | 459 | 817 | 551 | 699 | 789 | 352 | 288 | 270 | 244 |
| 17 | 334 | 201 | 102 | 127 | 462 | 1286 | 34 | 447 | 560 | 531 | 329 | 664 | 433 | 243 | 218 | 275 | 114 |
| 18 | 207 | 237 | 109 | 28 | 97 | 803 | 255 | 297 | 378 | 258 | 179 | 337 | 368 | 200 | 143 | 158 | 146 |
| 19 | 267 | 157 | 66 | 57 | 106 | 203 | 43 | 338 | 267 | 297 | 162 | 315 | 232 | 86 | 130 | 179 | 98 |
| 20 | 165 | 171 | 33 | 44 | 133 | 280 | 24 | 115 | 197 | 138 | 136 | 295 | 205 | 88 | 42 | 195 | 112 |
| 21 | 98 | 44 | 95 | 71 | 39 | 221 | 73 | 74 | 57 | 70 | 119 | 164 | 81 | 56 | 48 | 58 | 66 |
| 22 | 75 | 20 | 0 | 17 | 0 | 0 | 35 | 105 | 24 | 60 | 34 | 118 | 73 | 31 | 15 | 54 | 19 |
| 23 | 26 | 10 | 113 | 7 | 0 | 0 | 27 | 17 | 18 | 28 | 25 | 87 | 47 | 18 | 11 | 23 | 6 |
| 24 | 14 | 17 | 29 | 0 | 0 | 0 | 11 | 3 | 0 | 15 | 18 | 45 | 50 | 6 | 5 | 21 | 4 |
| 25 | 11 | 0 | 0 | 14 | 0 | 0 | 6 | 16 | 0 | 20 | 6 | 24 | 24 | 6 | 1 | 4 | 9 |
| 26 | 6 | 14 | 15 | 0 | 0 | 0 | 2 | 11 | 0 | 0 | 6 | 26 | 0 | 3 | 0 | 11 | 4 |
| TOTAL | 17921 | 14822 | 19124 | 22843 | 19358 | 13627 | 9488 | 9796 | 13296 | 13669 | 13188 | 10028 | 9240 | 9071 | 9917 | 7919 | 10090 |

Table 11. Coefficients of variation (/100) for estimated landings of 4T American plaice since 1976.

| AGE | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.847 | 0.000 | 0.000 | 0.126 | 0.198 | 0.000 | 0.000 | 0.043 | 0.030 | 0.044 | 0.000 | 0.064 |
| 5 | 0.313 | 0.185 | 0.365 | 0.000 | 0.000 | 0.387 | 0.000 | 0.076 | 0.299 | 0.193 | 0.273 | 0.188 | 0.132 | 0.066 | 0.067 | 0.057 | 0.067 |
| 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 | 0.048 | 0.042 | 0.061 |
| 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 | 0.043 | 0.031 | 0.035 |
| 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 | 0.035 | 0.043 | 0.026 |
| 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 | 0.028 | 0.024 | 0.025 |
| 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 | 0.029 | 0.026 | 0.021 |
| 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 | 0.029 | 0.028 | 0.026 |
| 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 | 0.033 | 0.025 | 0.032 |
| 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 | 0.031 | 0.029 | 0.049 |
| 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 | 0.046 | 0.040 | 0.053 |
| 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 | 0.043 | 0.042 | 0.044 |
| 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 | 0.066 | 0.054 | 0.066 |
| 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 | 0.078 | 0.049 | 0.067 |
| 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 | 0.045 | 0.038 | 0.064 |
| 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 | 0.055 | 0.044 | 0.047 |
| 20 | 0.117 | 0.087 | 0.551 | 0.422 | 0.703 | 0.331 | 0.560 | 0.333 | 0.310 | 0.174 | 0.127 | 0.070 | 0.174 | 0.036 | 0.032 | 0.020 | 0.017 |
| 21 | 0.153 | 0.220 | 0.236 | 0.401 | 0.000 | 0.231 | 0.422 | 0.333 | 0.577 | 0.237 | 0.122 | 0.093 | 0.265 | 0.036 | 0.027 | 0.054 | 0.018 |
| 22 | 0.197 | 0.311 | 0.000 | 0.589 | 0.281 | 0.244 | 0.400 | 0.352 | 0.739 | 0.252 | 0.166 | 0.103 | 0.274 | 0.052 | 0.048 | 0.032 | 0.035 |
| 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 | 0.065 | 0.040 | 0.023 |
| 24 | 0.369 | 0.314 | 0.379 | 0.000 | 0.000 | 0.297 | 0.960 | 0.970 | 0.000 | 0.522 | 0.202 | 0.176 | 0.390 | 0.029 | 0.069 | 0.050 | 0.029 |
| 25 | 0.353 | 0.000 | 0.000 | 0.586 | 0.000 | 0.597 | 0.769 | 0.711 | 0.000 | 0.615 | 0.271 | 0.211 | 0.504 | 0.036 | 0.025 | 0.049 | 0.030 |
| 26 | 0.577 | 0.317 | 0.508 | 0.000 | 0.000 | 0.457 | 0.000 | 0.914 | 0.000 | 0.000 | 0.370 | 0.245 | 0.000 | 0.059 | 0.000 | 0.057 | 0.024 |

Table 12. Mean catch per tow of American plaice in 4T from research surveys (Prince · 1.8)

| AGE | 1971 | 1972 | 1973 | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.24 | 1.04 | 0.88 | 0.82 | 0.48 | 0.00 | 0.71 | 0.00 | 0.08 | 2.64 | 2.76 | 1.69 | 2.94 | 0.22 | 1.36 | 3.76 | 0.49 | 0.79 | 0.75 | 0.88 | 1.86 | 2.20 |
| 2 | 8.41 | 8.16 | 7.14 | 16.56 | 4.58 | 5.23 | 5.63 | 1.30 | 1.37 | 7.13 | 14.65 | 13.81 | 11.96 | 2.78 | 6.66 | 3.72 | 5.54 | 4.16 | 4.34 | 14.90 | 16.92 | 7.15 |
| 3 | 26.07 | 14.66 | 23.35 | 57.59 | 22.79 | 52.49 | 80.11 | 10.26 | 6.81 | 35.17 | 29.90 | 14.49 | 29.46 | 5.13 | 17.39 | 13.24 | 12.88 | 16.39 | 12.15 | 34.94 | 27.79 | 27.39 |
| 4 | 43.52 | 33.63 | 32.56 | 116.32 | 85.16 | 175.19 | 228.75 | 83.33 | 66.07 | 80.13 | 72.80 | 18.18 | 35.37 | 23.95 | 22.11 | 32.01 | 24.31 | 28.29 | 26.98 | 56.68 | 52.35 | 40.11 |
| 5 | 41.88 | 32.68 | 37.79 | 97.87 | 159.00 | 257.07 | 312.34 | 110.19 | 181.36 | 90.62 | 97.81 | 34.73 | 43.37 | 32.29 | 41.75 | 28.52 | 36.39 | 34.54 | 37.40 | 78.69 | 65.03 | 46.68 |
| 6 | 43.55 | 36.62 | 29.36 | 80.00 | 81.14 | 202.69 | 183.02 | 122.79 | 163.86 | 113.05 | 115.73 | 30.03 | 42.15 | 30.48 | 37.40 | 43.28 | 31.70 | 53.86 | 28.32 | 59.62 | 65.61 | 45.80 |
| 7 | 45.03 | 42.02 | 24.69 | 52.60 | 62.77 | 96.91 | 121.98 | 113.10 | 184.15 | 79.65 | 125.42 | 44.95 | 31.36 | 27.54 | 27.01 | 26.82 | 32.47 | 34.18 | 31.17 | 30.83 | 46.59 | 30.34 |
| 8 | 27.44 | 28.91 | 27.33 | 40.63 | 39.77 | 42.43 | 53.74 | 74.98 | 138.53 | 64.02 | 72.78 | 61.72 | 50.35 | 25.84 | 20.37 | 15.55 | 19.41 | 32.50 | 20.53 | 29.08 | 28.15 | 21.33 |
| 9 | 9.50 | 13.15 | 21.39 | 45.37 | 28.44 | 38.05 | 21.81 | 24.63 | 63.76 | 33.11 | 49.09 | 32.29 | 47.79 | 23.77 | 17.54 | 10.52 | 16.63 | 19.72 | 12.86 | 16.37 | 26.66 | 10.67 |
| 10 | 6.65 | 7.74 | 9.52 | 27.72 | 19.16 | 26.51 | 14.65 | 15.92 | 32.86 | 17.42 | 25.68 | 21.50 | 27.65 | 28.18 | 13.12 | 6.66 | 10.35 | 9.65 | 8.83 | 10.57 | 13.08 | 8.62 |
| 11 | 5.89 | 3.67 | 5.05 | 12.39 | 14.70 | 17.88 | 8.67 | 8.39 | 18.31 | 10.55 | 11.67 | 9.06 | 27.48 | 10.46 | 17.89 | 8.90 | 7.82 | 6.99 | 4.53 | 7.42 | 8.73 | 4.67 |
| 12 | 3.79 | 3.53 | 3.87 | 4.04 | 4.31 | 11.82 | 5.93 | 4.27 | 9.89 | 5.84 | 5.65 | 3.98 | 14.04 | 8.97 | 18.47 | 13.98 | 7.30 | 5.81 | 4.23 | 3.42 | 6.07 | 3.32 |
| 13 | 2.78 | 1.83 | 3.16 | 3.37 | 2.40 | 7.03 | 3.68 | 4.67 | 6.05 | 4.10 | 3.25 | 2.05 | 5.85 | 4.23 | 15.31 | 9.54 | 2.52 | 5.39 | 3.13 | 2.74 | 2.87 | 1.98 |
| 14 | 2.36 | 1.17 | 3.58 | 3.42 | 1.85 | 3.65 | 2.13 | 1.53 | 5.57 | 2.15 | 2.04 | 2.21 | 2.86 | 1.60 | 7.78 | 11.04 | 2.97 | 4.51 | 2.25 | 1.16 | 2.70 | 1.15 |
| 15 | 1.45 | 0.51 | 1.94 | 2.44 | 1.11 | 1.58 | 1.19 | 1.41 | 2.94 | 0.90 | 1.47 | 1.24 | 2.28 | 1.61 | 3.19 | 3.82 | 1.22 | 2.39 | 1.37 | 1.32 | 1.94 | 0.69 |
| 16 | 1.22 | 0.64 | 1.48 | 1.24 | 1.07 | 1.37 | 0.32 | 0.55 | 2.14 | 0.46 | 1.29 | 1.25 | 1.23 | 0.65 | 2.99 | 2.34 | 0.68 | 1.02 | 0.77 | 0.59 | 1.16 | 0.57 |
| 17 | 1.07 | 0.16 | 1.34 | 0.60 | 0.15 | 1.44 | 0.44 | 0.32 | 0.53 | 0.36 | 0.42 | 0.96 | 1.22 | 0.55 | 2.08 | 2.45 | 0.60 | 1.25 | 0.63 | 0.24 | 1.04 | 0.23 |
| 18 | 0.47 | 0.16 | 0.59 | 0.54 | 1.09 | 0.55 | 0.13 | 0.14 | 0.69 | 0.11 | 0.17 | 0.39 | 0.90 | 0.53 | 1.60 | 2.61 | 0.43 | 0.36 | 0.22 | 0.18 | 0.55 | 0.21 |
| 19 | 0.12 | 0.06 | 1.65 | 0.17 | 0.58 | 0.04 | 0.60 | 0.14 | 0.38 | 0.14 | 0.36 | 0.51 | 0.33 | 0.41 | 0.73 | 0.60 | 0.41 | 0.34 | 0.21 | 0.12 | 0.25 | 0.14 |
| 20 | 0.36 | 0.06 | 1.68 | 0.35 | 0.92 | 0.66 | 0.12 | 0.28 | 1.01 | 0.18 | 0.38 | 0.44 | 0.58 | 0.61 | 2.42 | 2.34 | 0.55 | 0.68 | 0.32 | 0.16 | 0.20 | 0.12 |
| 1+ | 272.80 | 230.40 | 238.35 | 564.04 | 531.47 | 942.59 | 1045.95 | 578.20 | 886.36 | 547.73 | 633.32 | 295.48 | 379.17 | 229.80 | 277.17 | 241.70 | 214.64 | 262.81 | 200.99 | 349.91 | 369.55 | 253.37 |

Table 13. Mean catch per tow of American plaice in 4T expressed as Z scores ($x-\mu/s$).

| AGE | 1971 | 1972 | 1973 | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.2 | 0.0 | -0.2 | -0.3 | -0.7 | -1.6 | -0.4 | -1.6 | -1.4 | 1.3 | 1.4 | 0.6 | 1.5 | -1.2 | 0.3 | 1.9 | -0.7 | -0.3 | -0.4 | -0.2 | 0.8 | 1.0 |
| 2 | 0.4 | 0.4 | 0.2 | 1.4 | -0.5 | -0.3 | -0.2 | -2.3 | -2.2 | 0.2 | 1.2 | 1.1 | 0.9 | -1.2 | 0.1 | -0.8 | -0.2 | -0.6 | -0.5 | 1.2 | 1.4 | 0.2 |
| 3 | 0.3 | -0.5 | 0.2 | 1.5 | 0.1 | 1.4 | 2.0 | -1.1 | -1.7 | 0.8 | 0.5 | -0.6 | 0.5 | -2.1 | -0.3 | -0.7 | -0.7 | -0.4 | -0.8 | 0.8 | 0.4 | 0.4 |
| 4 | -0.2 | -0.6 | -0.6 | 1.3 | 0.8 | 1.9 | 2.3 | 0.8 | 0.5 | 0.7 | 0.6 | -1.5 | -0.5 | -1.1 | -1.2 | -0.6 | -1.0 | -0.8 | -0.9 | 0.2 | 0.1 | -0.3 |
| 5 | -0.6 | -1.0 | -0.8 | 0.6 | 1.3 | 1.9 | 2.2 | 0.7 | 1.4 | 0.5 | 0.6 | -0.9 | -0.6 | -1.0 | -0.6 | -1.2 | -0.8 | -0.9 | -0.8 | 0.3 | 0.0 | -0.5 |
| 6 | -0.5 | -0.8 | -1.2 | 0.4 | 0.5 | 1.9 | 1.8 | 1.1 | 1.6 | 1.0 | 1.0 | -1.1 | -0.6 | -1.1 | -0.8 | -0.5 | -1.0 | -0.2 | -1.2 | 0.0 | 0.1 | -0.4 |
| 7 | -0.1 | -0.3 | -1.2 | 0.1 | 0.4 | 1.2 | 1.5 | 1.4 | 2.2 | 0.8 | 1.6 | -0.2 | -0.8 | -1.0 | -1.0 | -1.0 | -0.7 | -0.6 | -0.8 | -0.8 | -0.1 | -0.8 |
| 8 | -0.5 | -0.4 | -0.5 | 0.2 | 0.2 | 0.3 | 0.7 | 1.4 | 2.5 | 1.1 | 1.3 | 1.0 | 0.6 | -0.6 | -1.1 | -1.6 | -1.2 | -0.2 | -1.1 | -0.4 | -0.5 | -1.0 |
| 9 | -1.7 | -1.1 | -0.1 | 1.3 | 0.4 | 0.9 | -0.1 | 0.1 | 1.9 | 0.7 | 1.4 | 0.6 | 1.4 | 0.1 | -0.5 | -1.5 | -0.6 | -0.3 | -1.1 | -0.6 | 0.3 | -1.5 |
| 10 | -1.5 | -1.2 | -0.8 | 1.3 | 0.5 | 1.2 | 0.0 | 0.2 | 1.6 | 0.4 | 1.1 | 0.8 | 1.3 | 1.3 | -0.2 | -1.5 | -0.7 | -0.8 | -1.0 | -0.6 | -0.2 | -1.0 |
| 11 | -0.9 | -1.9 | -1.2 | 0.6 | 0.9 | 1.3 | -0.1 | -0.2 | 1.4 | 0.3 | 0.5 | 0.0 | 2.2 | 0.2 | 1.3 | -0.1 | -0.3 | -0.6 | -1.4 | -0.4 | -0.1 | -1.4 |
| 12 | -0.9 | -1.1 | -0.9 | -0.8 | -0.7 | 1.3 | 0.0 | -0.7 | 1.0 | -0.1 | -0.1 | -0.8 | 1.7 | 0.8 | 2.2 | 1.7 | 0.4 | -0.1 | -0.7 | -1.1 | 0.0 | -1.2 |
| 13 | -0.6 | -1.4 | -0.4 | -0.2 | -0.9 | 1.2 | -0.1 | 0.4 | 0.9 | 0.1 | -0.3 | -1.2 | 0.8 | 0.2 | 2.7 | 1.8 | -0.8 | 0.7 | -0.4 | -0.6 | -0.6 | -1.3 |
| 14 | -0.2 | -1.4 | 0.5 | 0.5 | -0.6 | 0.6 | -0.4 | -0.9 | 1.3 | -0.3 | -0.4 | -0.3 | 0.1 | -0.9 | 1.9 | 2.5 | 0.2 | 0.9 | -0.3 | -1.4 | 0.0 | -1.4 |
| 15 | -0.1 | -2.4 | 0.5 | 1.0 | -0.7 | 0.0 | -0.6 | -0.2 | 1.4 | -1.2 | -0.1 | -0.5 | 0.8 | 0.1 | 1.5 | 1.9 | -0.5 | 0.9 | -0.3 | -0.3 | 0.5 | -1.7 |
| 16 | 0.4 | -0.8 | 0.8 | 0.4 | 0.2 | 0.6 | -2.1 | -1.1 | 1.4 | -1.4 | 0.5 | 0.4 | 0.4 | -0.8 | 2.1 | 1.6 | -0.7 | 0.1 | -0.5 | -0.9 | 0.3 | -1.0 |
| 17 | 0.7 | -1.8 | 1.0 | 0.0 | -1.8 | 1.1 | -0.4 | -0.9 | -0.2 | -0.7 | -0.5 | 0.6 | 0.9 | -0.2 | 1.6 | 1.8 | 0.0 | 0.9 | 0.0 | -1.2 | 0.7 | -1.3 |
| 18 | 0.2 | -1.1 | 0.5 | 0.4 | 1.2 | 0.4 | -1.4 | -1.3 | 0.7 | -1.6 | -1.0 | 0.0 | 1.0 | 0.3 | 1.7 | 2.3 | 0.1 | -0.1 | -0.7 | -1.0 | 0.4 | -0.8 |
| 19 | -0.9 | -1.8 | 2.1 | -0.5 | 0.9 | -2.2 | 0.9 | -0.8 | 0.4 | -0.8 | 0.3 | 0.8 | 0.2 | 0.5 | 1.2 | 0.9 | 0.5 | 0.3 | -0.3 | -0.9 | -0.1 | -0.8 |

Table 14. Total mortality (Z) of American plaice in 4T calculated from mean numbers per tow in research surveys.

| AGE | 1971 | 1972 | 1973 | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | -1.884 | -1.926 | -2.935 | -1.720 | -2.388 | -6.033 | -0.605 | -4.920 | -4.490 | -1.714 | -1.610 | -1.957 | 0.056 | -3.410 | -1.006 | -0.388 | -2.139 | -1.704 | -2.989 | -2.956 | -1.347 |
| 2 | -0.556 | -1.051 | -2.088 | -0.319 | -2.439 | -2.729 | -0.600 | -1.656 | -3.245 | -1.434 | 0.011 | -0.758 | 0.846 | -1.833 | -0.687 | -1.242 | -1.085 | -1.072 | -2.086 | -0.623 | -0.482 |
| 3 | -0.255 | -0.798 | -1.606 | -0.391 | -2.040 | -1.472 | -0.039 | -1.862 | -2.465 | -0.728 | 0.498 | -0.892 | 0.207 | -1.461 | -0.610 | -0.608 | -0.787 | -0.498 | -1.540 | -0.404 | -0.367 |
| 4 | 0.286 | -0.117 | -1.101 | -0.313 | -1.105 | -0.578 | 0.730 | -0.778 | -0.316 | -0.199 | 0.740 | -0.869 | 0.091 | -0.556 | -0.255 | -0.128 | -0.351 | -0.279 | -1.070 | -0.137 | 0.115 |
| 5 | 0.134 | 0.107 | -0.750 | 0.187 | -0.243 | 0.340 | 0.934 | -0.397 | 0.473 | -0.245 | 1.181 | -0.194 | 0.353 | -0.147 | -0.036 | -0.106 | -0.392 | 0.199 | -0.466 | 0.182 | 0.351 |
| 6 | 0.036 | 0.394 | -0.583 | 0.243 | -0.178 | 0.508 | 0.481 | -0.405 | 0.721 | -0.104 | 0.946 | -0.043 | 0.426 | 0.121 | 0.333 | 0.287 | -0.075 | 0.547 | -0.085 | 0.247 | 0.771 |
| 7 | 0.443 | 0.430 | -0.498 | 0.280 | 0.392 | 0.590 | 0.487 | -0.203 | 1.057 | 0.090 | 0.709 | -0.113 | 0.194 | 0.302 | 0.552 | 0.323 | -0.001 | 0.510 | 0.069 | 0.091 | 0.781 |
| 8 | 0.736 | 0.301 | -0.507 | 0.357 | 0.044 | 0.665 | 0.780 | 0.162 | 1.431 | 0.266 | 0.813 | 0.256 | 0.751 | 0.387 | 0.661 | -0.067 | -0.016 | 0.927 | 0.226 | 0.087 | 0.970 |
| 9 | 0.205 | 0.323 | -0.259 | 0.862 | 0.070 | 0.954 | 0.315 | -0.288 | 1.298 | 0.254 | 0.826 | 0.155 | 0.528 | 0.594 | 0.968 | 0.016 | 0.544 | 0.803 | 0.196 | 0.224 | 1.129 |
| 10 | 0.594 | 0.427 | -0.263 | 0.634 | 0.069 | 1.118 | 0.557 | -0.140 | 1.136 | 0.401 | 1.042 | -0.245 | 0.972 | 0.454 | 0.388 | -0.161 | 0.393 | 0.756 | 0.174 | 0.191 | 1.030 |
| 11 | 0.512 | -0.053 | 0.223 | 1.056 | 0.218 | 1.104 | 0.708 | -0.164 | 1.143 | 0.624 | 1.076 | -0.438 | 1.120 | -0.569 | 0.247 | 0.198 | 0.297 | 0.502 | 0.281 | 0.201 | 0.967 |
| 12 | 0.728 | 0.111 | 0.138 | 0.521 | -0.489 | 1.167 | 0.239 | -0.348 | 0.881 | 0.586 | 1.014 | -0.385 | 1.200 | -0.535 | 0.661 | 1.713 | 0.303 | 0.619 | 0.434 | 0.175 | 1.120 |
| 13 | 0.865 | -0.671 | -0.079 | 0.600 | -0.419 | 1.194 | 0.878 | -0.176 | 1.035 | 0.698 | 0.386 | -0.333 | 1.296 | -0.609 | 0.327 | 1.167 | -0.582 | 0.874 | 0.993 | 0.015 | 0.915 |
| 14 | 1.532 | -0.506 | 0.383 | 1.125 | 0.158 | 1.121 | 0.413 | -0.653 | 1.823 | 0.380 | 0.498 | -0.031 | 0.575 | -0.690 | 0.711 | 2.203 | 0.217 | 1.191 | 0.533 | -0.514 | 1.364 |
| 15 | 0.818 | -1.065 | 0.448 | 0.824 | -0.210 | 1.597 | 0.772 | -0.417 | 1.855 | -0.360 | 0.162 | 0.008 | 1.255 | -0.619 | 0.310 | 1.726 | 0.179 | 1.133 | 0.842 | 0.129 | 1.225 |
| 16 | 2.031 | -0.739 | 0.903 | 2.112 | -0.297 | 1.136 | 0.000 | 0.037 | 1.782 | 0.091 | 0.295 | 0.024 | 0.805 | -1.163 | 0.199 | 1.361 | -0.609 | 0.482 | 1.166 | -0.567 | 1.618 |
| 17 | 1.900 | -1.305 | 0.909 | -0.597 | -1.299 | 2.405 | 1.145 | -0.768 | 1.572 | 0.750 | 0.074 | 0.065 | 0.834 | -1.068 | -0.227 | 1.740 | 0.511 | 1.737 | 1.253 | -0.829 | 1.600 |
| 18 | 2.058 | -2.333 | 1.244 | -0.071 | 3.305 | -0.087 | -0.074 | -0.999 | 1.595 | -1.186 | -1.099 | 0.167 | 0.786 | -0.320 | 0.981 | 1.851 | 0.235 | 0.539 | 0.606 | -0.329 | 1.368 |
| 19 | 0.693 | -3.332 | 1.551 | -1.689 | -0.129 | -1.099 | 0.762 | -1.976 | 0.747 | -0.999 | -0.201 | -0.129 | -0.614 | -1.775 | -1.165 | 0.087 | -0.506 | 0.061 | 0.272 | -0.511 | 0.734 |

Table 15. Coefficients of variation (/100) for research surveys. "." indicates no data.

| AGE | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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 | . | . | 0.2153 | 0.2285 |
| 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 | . | 0.1585 | 0.1722 |
| 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 | 0.297 | 0.1278 | 0.1241 |
| 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 | 0.231 | 0.1184 | 0.1123 |
| 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 | 0.183 | 0.1350 | 0.1030 |
| 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 | 0.100 | 0.1455 | 0.1093 |
| 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 | 0.085 | 0.1457 | 0.1026 |
| 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 | 0.141 | 0.1415 | 0.1007 |
| 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 | 0.147 | 0.1415 | 0.1029 |
| 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 | 0.120 | 0.1327 | 0.1064 |
| 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 | 0.121 | 0.1308 | 0.1080 |
| 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 | 0.116 | 0.1269 | 0.1066 |
| 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 | 0.057 | 0.1251 | 0.1170 |
| 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 | 0.105 | 0.1344 | 0.1011 |
| 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 | 0.065 | 0.4483 | 0.1126 |
| 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 | 0.101 | 0.1222 | 0.1098 |
| 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 | 0.086 | 0.1048 | 0.1439 |
| 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 | 0.173 | 0.1176 | 0.1514 |
| 19 | 1.0000 | 0.4738 | 0.3300 | 0.3760 | 0.4075 | 0.3431 | 0.3555 | 0.3878 | 0.3934 | 0 | 0.3709 | . | . | 0.2026 | 0.178 | 0.1116 | 0.1736 |
| 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 | 0.229 | 0.1990 | 0.0842 |
| 21 | 0.2945 | . | . | 0.5476 | 0.7075 | . | 1.0000 | 0.3592 | 0 | 0.6011 | 0 | 0 | . | 0.2937 | 0.166 | 0.2542 | 0.3367 |
| 22 | 1.0000 | . | 0.5856 | 0.4663 | 1.0000 | 0.4514 | 0.4541 | 0.8505 | 0 | 0 | 0 | . | . | 0.2208 | 0.223 | 0.5100 | .1683 |
| 23 | . | 0.6446 | . | . | . | . | 0.6346 | . | 0 | 0 | 0.6812 | . | . | 0.2208 | 0.376 | 0.4217 | .1683 |
| 24 | 1.0000 | . | . | 0.1500 | . | 0.7086 | . | 0.5335 | 0 | 0 | 0 | . | . | 0.2464 | . | 0.5800 | .5600 |
| 25 | . | . | . | . | . | . | 1.0000 | . | . | . | 0 | . | . | 0.7221 | 0.393 | 0.5800 | .7100 |
| 26 | . | . | . | . | . | . | 0.5210 | 0.0200 | . | 0 | 0 | . | . | 0.3294 | . | . | . |

Table 16. Results of analysis of variance of multiplicative model of the effects of age, year class (YC) and period (PER). Four periods are 1971-75 (period 1), 1976-80 (period 2), 1981-86 (period 3), 1987-92 (period 4).

| Class | Levels | Values |
|---|---|---|
| AGE | 17 | 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 |
| YC | 27 | 1961 1962 1963 1964 1965 1966 1967 1968 1969 1970 1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 |
| PER | 4 | 1 2 3 4 |

Number of observations in data set = 326

Dependent Variable: LNCPUE

| Source | DF | Sum of Squares | Mean Square | F Value | Pr > F |
|---|---|---|---|---|---|
| Model | 88 | 993.43485572 | 11.28903245 | 55.24 | 0.0001 |
| Error | 237 | 48.43123005 | 0.20435118 | | |
| Corrected Total | 325 | 1041.86608576 | | | |

| R-Square | C.V. | Root MSE | LNCPUE Mean |
|---|---|---|---|
| 0.953515 | 20.48657 | 0.4520522 | 2.2065778 |

| Source | DF | Type I SS | Mean Square | F Value | Pr > F |
|---|---|---|---|---|---|
| AGE | 16 | 924.83732066 | 57.80233254 | 282.86 | 0.0001 |
| YC | 26 | 44.30587513 | 1.70407212 | 8.34 | 0.0001 |
| AGE*PER | 46 | 24.29165993 | 0.52807956 | 2.58 | 0.0001 |

| Source | DF | Type III SS | Mean Square | F Value | Pr > F |
|---|---|---|---|---|---|
| AGE | 16 | 262.63756276 | 16.41484767 | 80.33 | 0.0001 |
| YC | 26 | 22.77985418 | 0.87614824 | 4.29 | 0.0001 |
| AGE*PER | 46 | 24.29165993 | 0.52807956 | 2.58 | 0.0001 |

Table 17. Estimated number of discarded American plaice ('000) in the 4T commercial fishery.

| AGE | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 |
|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 24 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 0 | 0 |
| 3 | 0 | 55 | 15 | 8 | 0 | 0 | 134 | 5 | 35 | 14 |
| 4 | 88 | 205 | 557 | 914 | 130 | 136 | 384 | 303 | 824 | 336 |
| 5 | 668 | 571 | 1873 | 2171 | 1222 | 1069 | 2378 | 2188 | 3686 | 1750 |
| 6 | 2208 | 1573 | 2624 | 4440 | 4993 | 4941 | 4578 | 4453 | 8115 | 5178 |
| 7 | 2486 | 2950 | 3300 | 5691 | 7466 | 4998 | 10233 | 4551 | 10123 | 6336 |
| 8 | 4989 | 3571 | 5079 | 3600 | 7078 | 7712 | 8998 | 5483 | 7661 | 5457 |
| 9 | 7024 | 5456 | 4045 | 3607 | 6332 | 6142 | 7459 | 3161 | 7250 | 2453 |
| 10 | 5549 | 7311 | 4188 | 1510 | 5168 | 3232 | 6241 | 2109 | 3779 | 2210 |
| 11 | 5875 | 3245 | 5026 | 2245 | 4558 | 2595 | 3465 | 1328 | 2609 | 1070 |
| 12 | 2721 | 2988 | 4132 | 3139 | 3402 | 2197 | 3223 | 681 | 1712 | 766 |
| 13 | 556 | 1333 | 3249 | 1570 | 1681 | 1766 | 2181 | 518 | 745 | 313 |
| 14 | 179 | 271 | 2788 | 841 | 1268 | 1629 | 1275 | 107 | 560 | 254 |
| 15 | 94 | 44 | 944 | 857 | 809 | 566 | 664 | 147 | 492 | 134 |
| 16 | 0 | 0 | 501 | 452 | 363 | 102 | 270 | 12 | 198 | 130 |
| 17 | 13 | 11 | 202 | 194 | 136 | 92 | 115 | 4 | 379 | 21 |
| 18 | 0 | 0 | 162 | 2 | 0 | 7 | 7 | 0 | 183 | 46 |
| 19 | 0 | 0 | 105 | 174 | 0 | 0 | 0 | 4 | 88 | 14 |
| 20 | 0 | 0 | 32 | 0 | 0 | 0 | 0 | 0 | 0 | 4 |
| 21 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 14 |
| TOTAL | 32473 | 29616 | 38822 | 31432 | 44607 | 37184 | 51602 | 25065 | 48438 | 26498 |

Table 18. Mean weight at age (g) of American plaice from research vessel surveys. Males in upper panel, females in lower panel.

| AGE | 71 | 1972 | 1973 | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4 | 68 | 77 | 79 | 53 | 64 | 71 | 61 | 51 | 43 | 74 | 76 | 74 | 71 | 89 | 80 | 90 | 83 | 78 | 70 | 76 | 96 | 77 |
| 5 | 109 | 124 | 123 | 98 | 104 | 107 | 90 | 81 | 64 | 95 | 98 | 112 | 91 | 107 | 124 | 116 | 113 | 115 | 102 | 114 | 128 | 111 |
| 6 | 146 | 170 | 153 | 152 | 159 | 158 | 130 | 107 | 87 | 115 | 122 | 130 | 112 | 128 | 151 | 155 | 155 | 148 | 128 | 140 | 144 | 132 |
| 7 | 188 | 206 | 189 | 198 | 209 | 208 | 189 | 149 | 117 | 153 | 141 | 152 | 127 | 155 | 171 | 188 | 167 | 165 | 159 | 168 | 168 | 159 |
| 8 | 214 | 245 | 203 | 231 | 242 | 249 | 228 | 192 | 157 | 204 | 182 | 170 | 126 | 175 | 216 | 210 | 192 | 187 | 182 | 194 | 193 | 177 |
| 9 | 283 | 353 | 233 | 260 | 265 | 277 | 262 | 253 | 198 | 238 | 210 | 205 | 140 | 216 | 215 | 237 | 194 | 214 | 209 | 205 | 206 | 203 |
| 10 | 304 | 361 | 260 | 296 | 301 | 319 | 344 | 271 | 219 | 295 | 261 | 264 | 159 | 225 | 238 | 271 | 219 | 215 | 224 | 223 | 232 | 230 |
| 11 | 365 | 428 | 297 | 352 | 356 | 339 | 366 | 308 | 285 | 397 | 284 | 300 | 180 | 303 | 258 | 308 | 240 | 244 | 241 | 226 | 243 | 241 |
| 12 | 420 | 537 | 417 | 353 | 567 | 390 | 396 | 394 | 337 | 388 | 368 | 274 | 180 | 348 | 262 | 310 | 227 | 243 | 242 | 266 | 250 | 252 |

| | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4 | 73 | 77 | 81 | 51 | 60 | 68 | 56 | 44 | 44 | 72 | 77 | 77 | 71 | 89 | 80 | 90 | 80 | 80 | 75 | 80 | 94 | 82 |
| 5 | 121 | 124 | 128 | 107 | 109 | 100 | 90 | 96 | 65 | 110 | 107 | 131 | 100 | 107 | 124 | 116 | 134 | 125 | 111 | 125 | 141 | 125 |
| 6 | 166 | 200 | 169 | 165 | 192 | 168 | 142 | 120 | 112 | 131 | 140 | 165 | 134 | 128 | 151 | 155 | 178 | 174 | 154 | 174 | 187 | 176 |
| 7 | 229 | 240 | 210 | 202 | 266 | 251 | 209 | 196 | 146 | 187 | 167 | 193 | 154 | 155 | 171 | 188 | 209 | 206 | 214 | 238 | 238 | 234 |
| 8 | 293 | 323 | 281 | 282 | 314 | 333 | 323 | 265 | 208 | 248 | 214 | 222 | 171 | 175 | 216 | 210 | 261 | 257 | 242 | 284 | 274 | 277 |
| 9 | 357 | 405 | 361 | 375 | 384 | 440 | 419 | 391 | 288 | 322 | 263 | 278 | 218 | 216 | 215 | 237 | 298 | 298 | 303 | 315 | 319 | 328 |
| 10 | 476 | 568 | 424 | 468 | 458 | 471 | 500 | 459 | 382 | 411 | 346 | 334 | 260 | 225 | 238 | 271 | 310 | 355 | 338 | 364 | 339 | 383 |
| 11 | 541 | 788 | 554 | 554 | 510 | 626 | 629 | 658 | 553 | 552 | 459 | 473 | 306 | 303 | 258 | 308 | 346 | 381 | 375 | 445 | 372 | 400 |
| 12 | 654 | 869 | 679 | 744 | 742 | 689 | 793 | 655 | 593 | 674 | 642 | 659 | 372 | 348 | 262 | 310 | 387 | 386 | 451 | 448 | 367 | 444 |

Table 19. Mean weight (kg) and partial recruitment (PR) calculated for the landed catch of American plaice in 4T and their estimated catch, including discards.

| | LANDED | | CAUGHT | |
|---|---|---|---|---|
| AGE | Wt | PR | Wt | PR |
| 2 | 0.132 | 0.005 | 0.143 | 0.002 |
| 3 | 0.066 | 0.005 | 0.146 | 0.004 |
| 4 | 0.193 | 0.009 | 0.182 | 0.023 |
| 5 | 0.249 | 0.012 | 0.200 | 0.084 |
| 6 | 0.300 | 0.037 | 0.220 | 0.231 |
| 7 | 0.349 | 0.089 | 0.252 | 0.434 |
| 8 | 0.387 | 0.179 | 0.274 | 0.612 |
| 9 | 0.411 | 0.356 | 0.299 | 0.742 |
| 10 | 0.443 | 0.529 | 0.320 | 0.892 |
| 11 | 0.489 | 0.674 | 0.336 | 0.946 |
| 12 | 0.582 | 1.000 | 0.345 | 1.000 |
| 13 | 0.648 | 1.000 | 0.355 | 1.000 |
| 14 | 0.732 | 1.000 | 0.368 | 1.000 |
| 15 | 0.825 | 1.000 | 0.389 | 1.000 |
| 16 | 0.997 | 1.000 | 0.411 | 1.000 |
| 17 | 1.092 | 1.000 | 0.452 | 1.000 |
| 18 | 1.146 | 1.000 | 0.471 | 1.000 |

Table 20. Biomass (t) of American plaice in 4T based on RV surveys.

| | AGES 1-9 | | | AGES 10+ | | |
|---|---|---|---|---|---|---|
| YEAR | MALES | FEMALES | TOTAL | MALES | FEMALES | TOTAL |
| 1987 | 26,893 | 24,089 | 50,982 | 6,198 | 18,884 | 25,082 |
| 1988 | 30,995 | 29,348 | 60,343 | 7,548 | 18,620 | 26,168 |
| 1989 | 18,949 | 21,869 | 40,818 | 5,729 | 16,760 | 22,488 |
| 1990 | 32,323 | 30,997 | 63,320 | 5,405 | 12,391 | 17,796 |
| 1991 | 40,793 | 43,406 | 84,119 | 9,169 | 12,690 | 21,859 |
| 1992 | 25,986 | 26,012 | 51,998 | 4,991 | 7,625 | 12,616 |

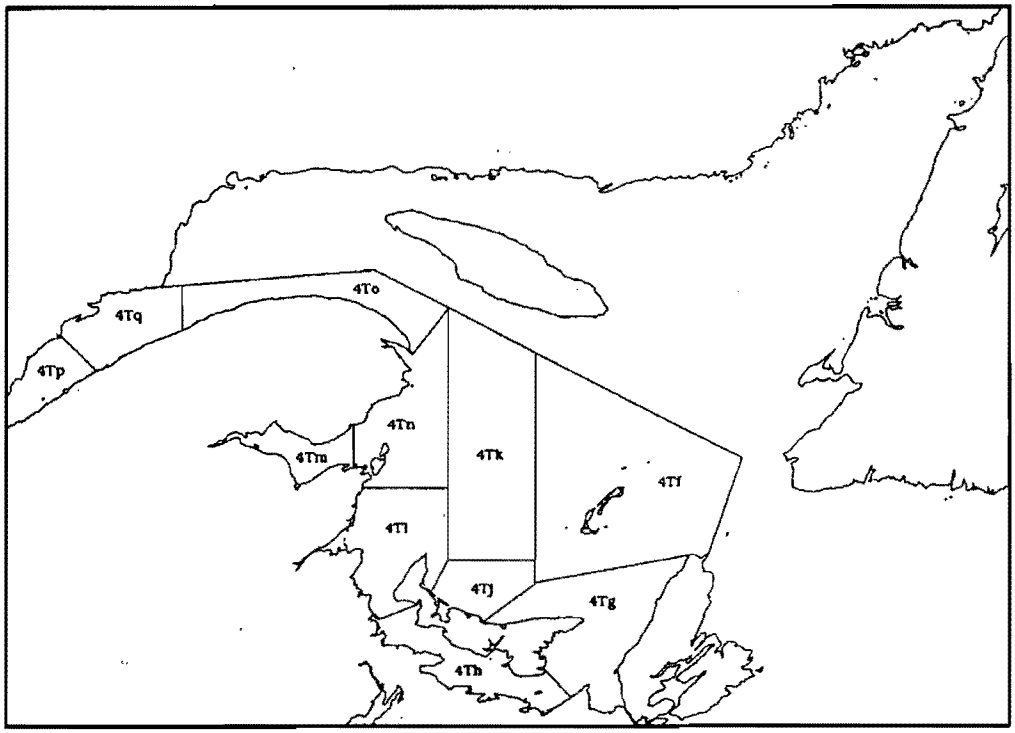


Figure 1. Gulf of St. Lawrence showing unit areas of NAFO Division 4T.

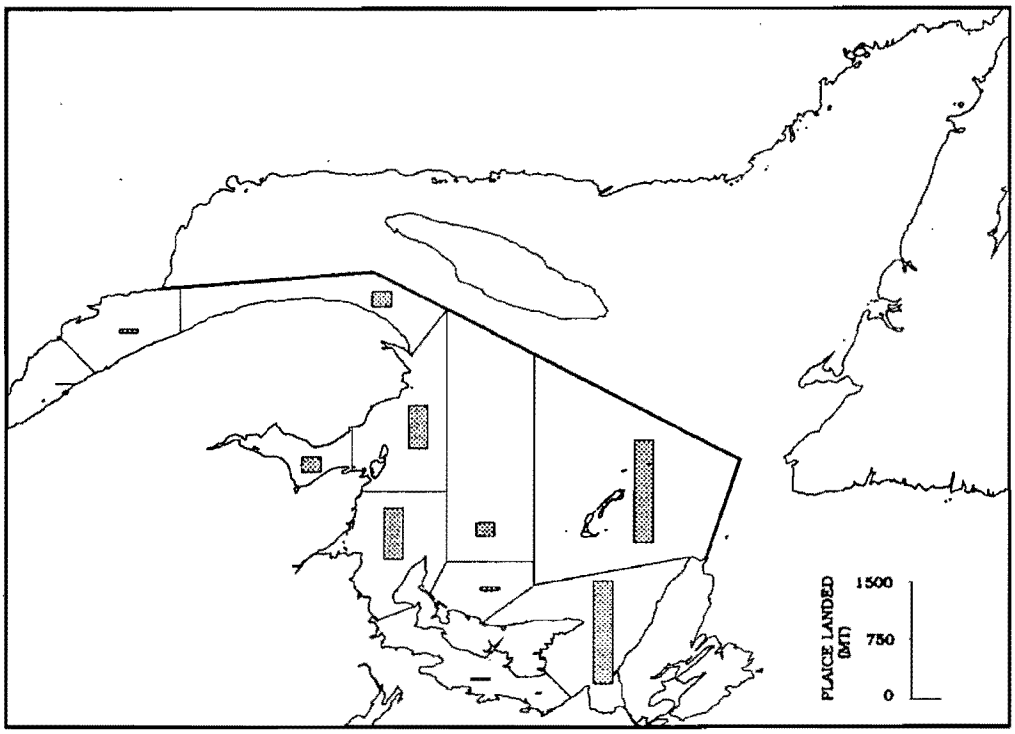


Figure 2. American plaice landings by 4T unit area.

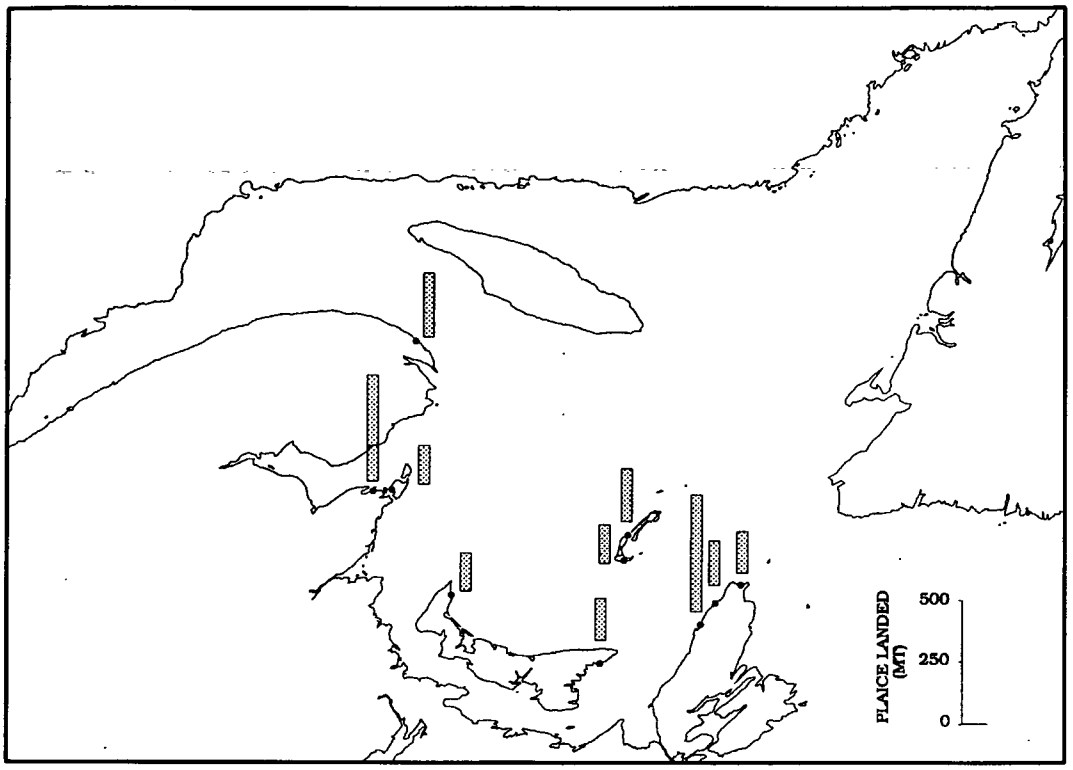


Figure 3. Distribution of American plaice landings (4T, 1991) by landing port, showing the 10-most important landing ports for plaice.

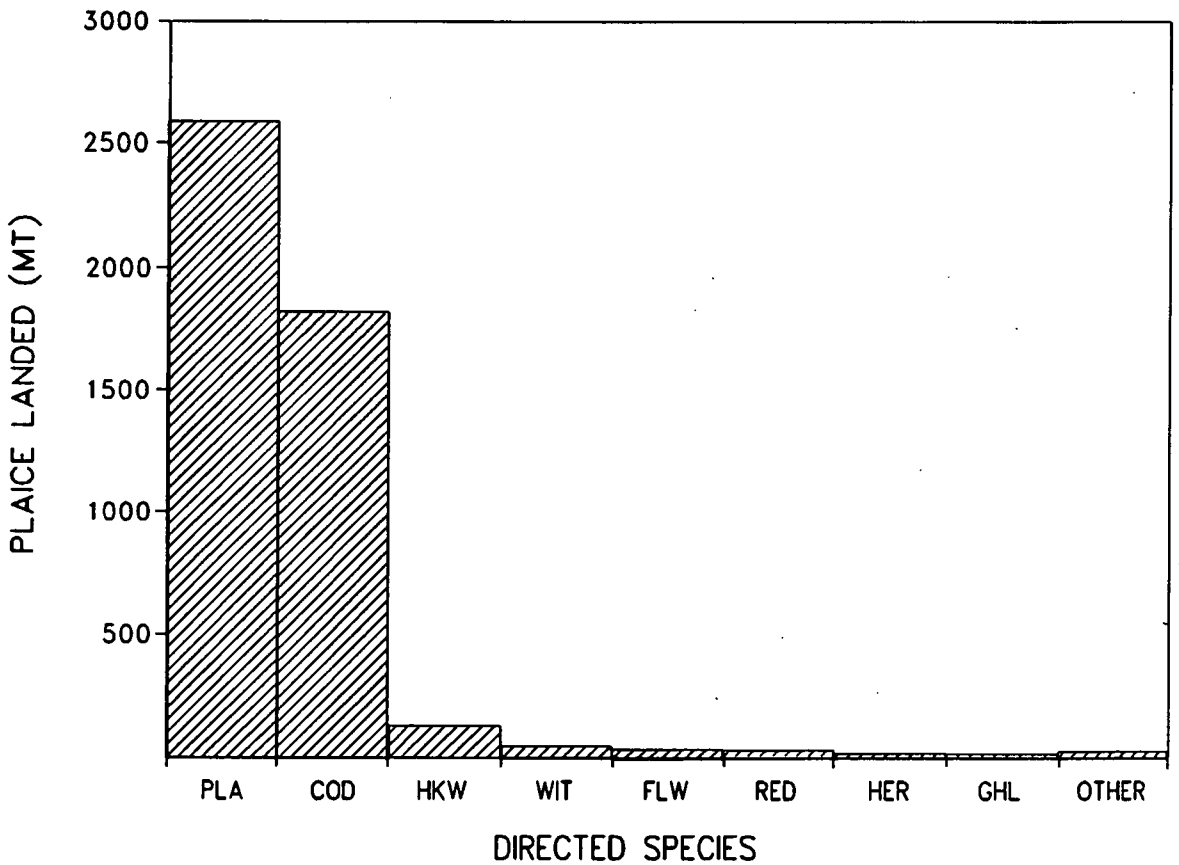


Figure 4. Plaice landings in 4T (1991) by directed species.

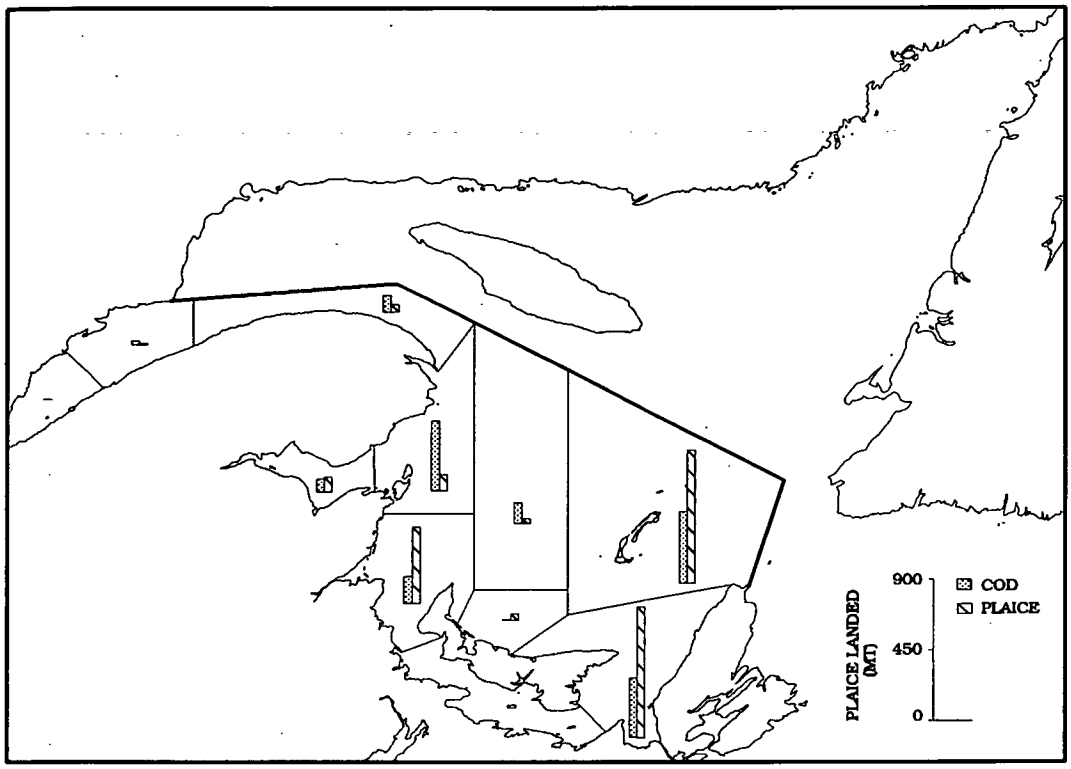


Figure 5. Plaice landings in 4T unit areas during 1991 by directed species.

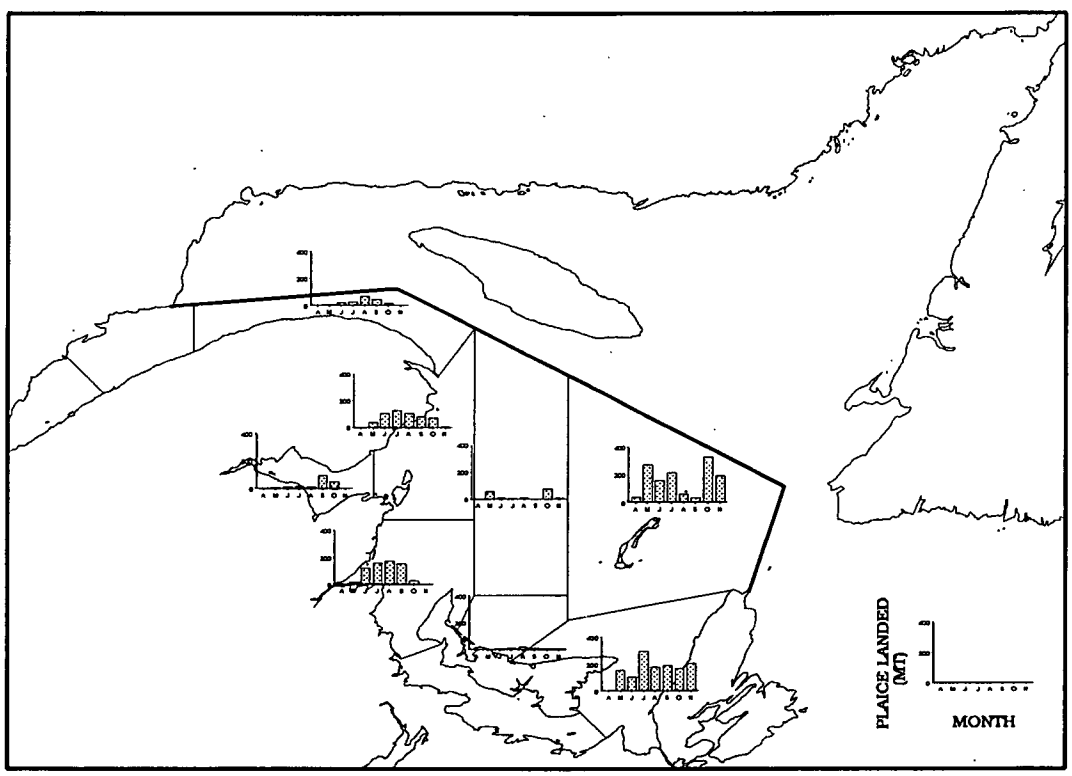


Figure 6. Monthly landings of American plaice in 4T unit areas during 1991.

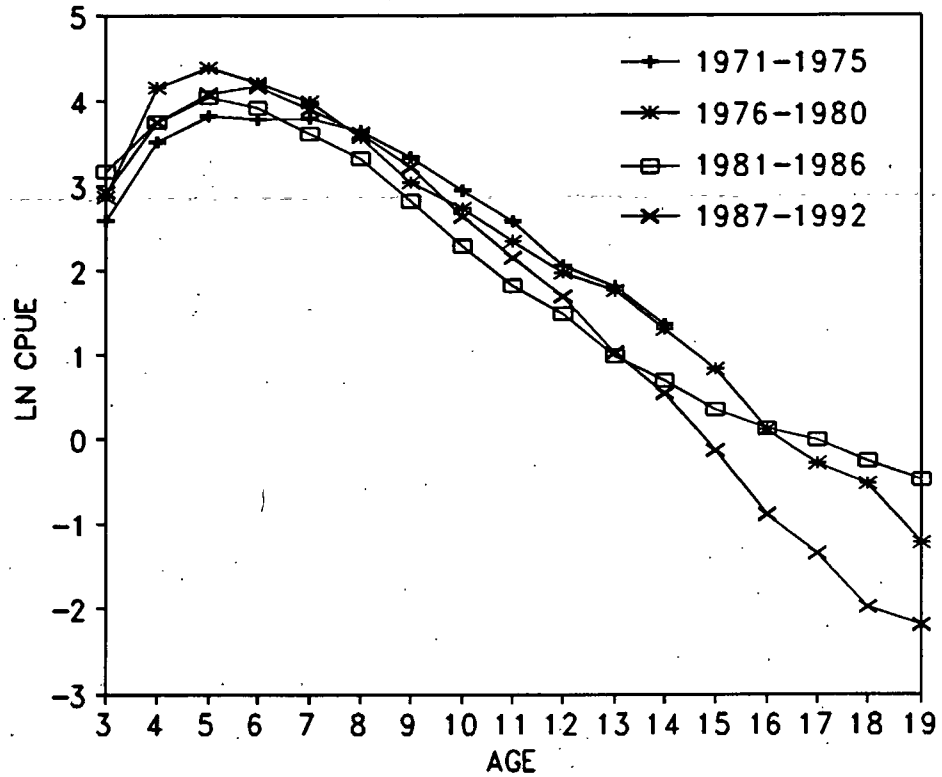


Figure 7. Standardized catch per unit effort (CPUE) of 4T plaice in relation to plaice age, based on multiplicative model of research survey data.

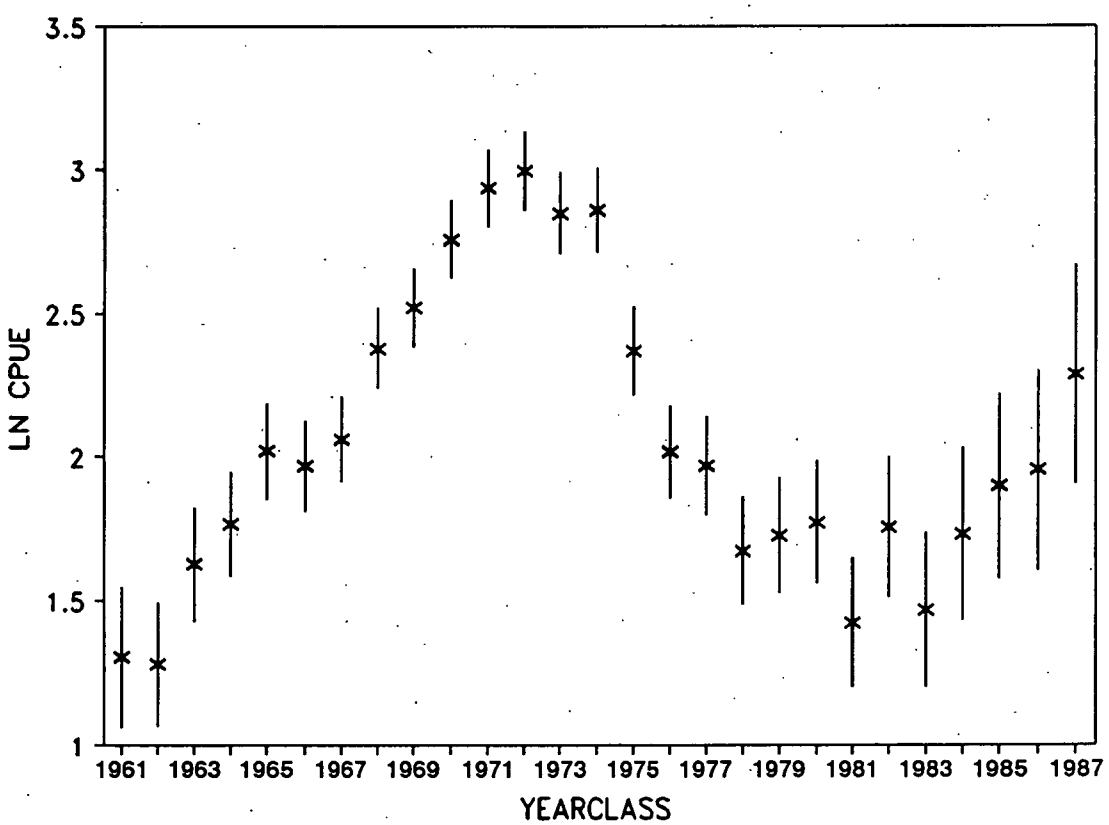


Figure 8. Standardized catch per unit effort (CPUE) of 4T plaice yearclasses based on multiplicative model of research survey data. Vertical bars indicate limits of one standard error.

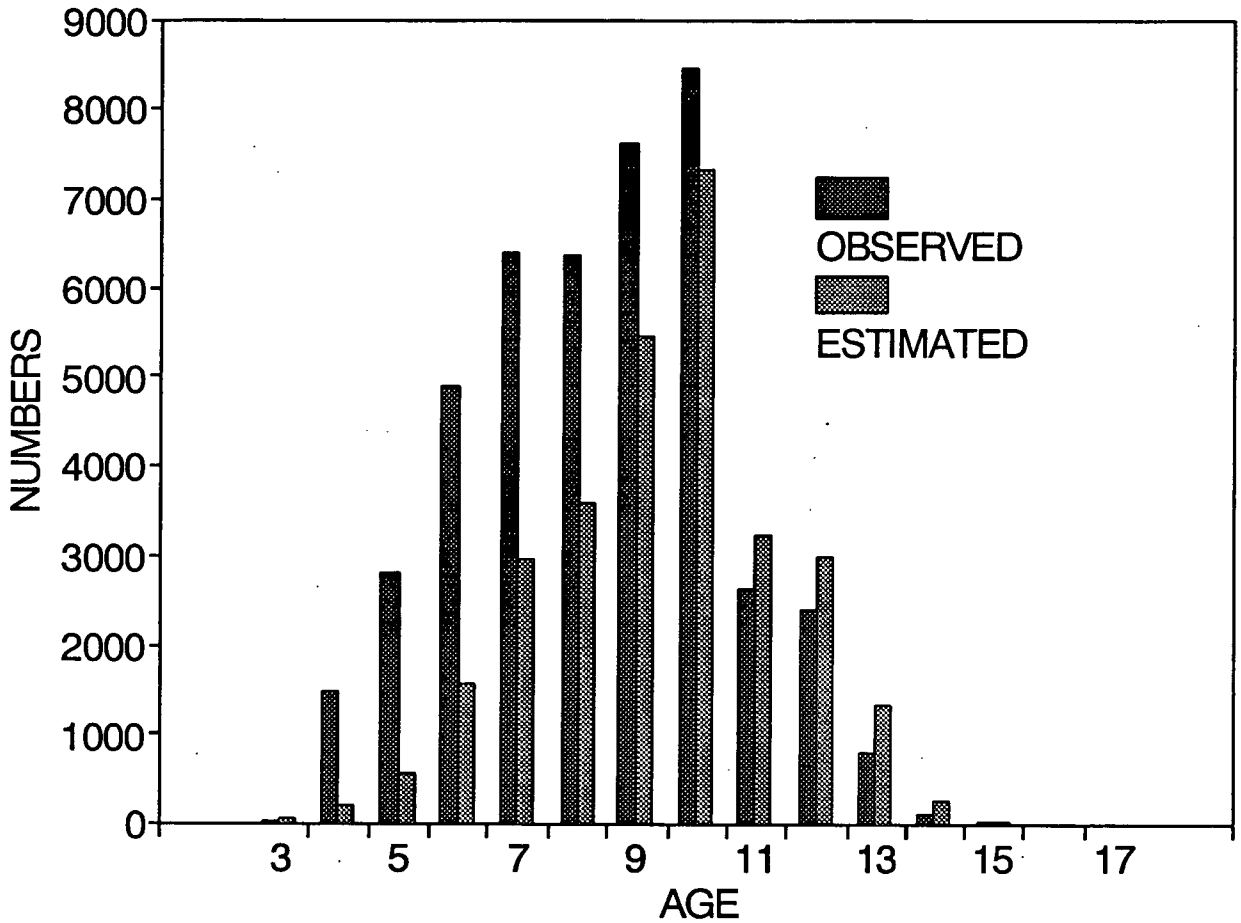


Figure 9. Comparison of observed and estimated discards in the 1984 4T plaice fishery. Observed data are from Chouinard and Metuzals (1985). Estimated numbers are in thousands (Table 17).