

Not to be cited without  
permission of the authors<sup>1</sup>

Canadian Atlantic Fisheries  
Scientific Advisory Committee

CAFSAC Research Document 91/76

Ne pas citer sans  
autorisation des auteurs<sup>1</sup>

Comité scientifique consultatif des  
pêches canadiennes dans l'Atlantique

CSCPCA Document de recherche 91/76

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

by

**Ross Tallman**

and

**Isabelle Forest-Gallant**

**Department of Fisheries & Oceans  
Marine and Anadromous Fish Division  
Science Branch  
Gulf Fisheries Centre  
P.O. Box 5030  
Moncton, New Brunswick  
E1C 9B6**

<sup>1</sup>This series documents the scientific basis for fisheries management advice in Atlantic Canada. As such, it addresses the issues of the day in the time frames required and the Research Documents it contains are not intended as definitive statements on the subjects addressed but rather as progress reports on ongoing investigations.

Research Documents are produced in the official language in which they are provided to the Secretariat by the author.

<sup>1</sup>Cette série documente les bases scientifiques des conseils de gestion des pêches sur la côte atlantique du Canada. Comme telle, elle couvre les problèmes actuels selon les échéanciers voulus et les Documents de recherche qu'elle contient ne doivent pas être considérés comme des énoncés finals sur les sujets traités mais plutôt comme des rapports d'étape sur les études en cours.

Les Documents de recherche sont publiés dans la langue officielle utilisée par les auteurs dans le manuscrit envoyé au secrétariat.

### ABSTRACT

The provisional landings of American plaice in NAFO Division 4T during 1990 were 5,614 t. The proportion of the total landings taken by seines was 44%, representing a decrease of 2% from 1989. Bottom trawls took 37% of the total landings. RV mean numbers per tow during 1990 were the highest since 1983. The increase appeared to be due to strong year-classes from 1984 to 88. The average total mortality estimates for ages 8-18 from the RV data were 0.37 for 1971-79 and 0.54 for 1980-89. Assuming natural mortality to be 0.2, fishing mortality during the 1980s was above  $F_{0.1}$ . Status quo projection gave a yield of 4,242 t. Fifteen per cent of the mature biomass, as determined from the RV survey, gave a yield of 3,433 t. Therefore, a TAC of between 3,000 t and 5,000 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. One of the conservation measures that can be used to protect fishery resources is the closure of areas where juveniles are abundant. The distribution of young fish, as determined from the combined RV data from 1971-1989, showed two distinct centers of distribution: a major settling area in the Baie des Chaleurs and a lesser one between Prince Edward Island and Cape Breton Island. With increasing age, the distribution spread from these points to a relatively even distribution throughout the Magdalen Shallows by ages 9 and 10. Strata 418, 419 and 434 were the most important for the youngest ages. The pattern for ages 1 to 10 from the 1990 RV data showed a similar pattern overall with two important foci. However, the highest catches of age 2 plaice were in stratum 22, which lies due east of the Acadian Peninsula.

## RÉSUMÉ

Selon les données provisoires, les débarquements de plie canadienne dans la division 4T de l'OPANO étaient de 5 614 t en 1990. Les seigneurs ont capturé 44 p. 100 de ce total, ce qui représente une baisse de 2 p. 100 par rapport à 1989. Les pêcheurs au chalut de fond ont capturé 37 p. 100 du total des débarquements. Quant au navire de recherche, la moyenne de ses débarquements de 1990 n'avait jamais été aussi élevée depuis 1983. L'augmentation semble être due aux fortes classes de 1984 à 1988. D'après les données obtenues par le navire de recherche, on a estimé que la mortalité globale moyenne chez les classes d'âge 8 à 18 s'est située à 0,37 pour 1971-1979 et à 0,54 pour 1980-1989. En présumant que la mortalité naturelle était de 0,2, la mortalité par pêche au cours des années 1980 aurait donc été supérieure au  $F_{0,1}$ . En maintenant le statu quo, on projetait un rendement de 4242 t. D'après les études du navire de recherche, quinze pour cent de la biomasse mature a donné un rendement de 3433 t. Par conséquent, un TPA qui se situerait entre 3000 t et 5000 t est jugé plus près du niveau  $F_{0,1}$  que le TPA actuel de 10 000 t. Toutefois l'imposition d'un contingent limitatif pourrait entraîner une augmentation des rejets en mer. Une des mesures de conservation que l'on pourrait adopter pour protéger les ressources halieutiques serait d'interdire la pêche dans les secteurs où les juvéniles sont abondants. L'ensemble des données recueillies par le navire de recherche entre 1971 et 1989 a permis d'identifier deux centres de distribution distincts des juvéniles : une concentration majeure dans la baie des Chaleurs et une autre moins importante entre l'île du Prince Édouard et l'île du Cap Breton. Rendus à l'âge 9 ou 10, la plie canadienne semble s'éloigner de ces deux points de concentration pour se répartir de façon plus uniforme à travers les petits fonds des îles de la Madeleine. Les strates 418, 419 et 434 étaient les plus importants lieux de fréquentation des individus plus jeunes. Les données obtenues par le navire de recherche en 1990 donnent cette même distribution dans l'ensemble de la région à l'étude et on compte deux importants points de convergence. On note cependant que les prises les plus élevées de la plie de deux ans ont été réalisées dans la strate 22 qui est située plein est par rapport à la péninsule acadienne.

## INTRODUCTION

Since 1965, the nominal landings of American plaice from NAFO Division 4T have varied from a high of 11,780 t in 1966 to a low of 4,987 t in 1989 (Table 1). A precautionary TAC of 10,000 t has been imposed on the landings of this fishery since 1977. The average annual landings have been over 1,500 t less than this. Landings during the last three years were less than 7,000 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. American plaice is exploited by fishermen using mobile gears (M.G.), such as otter trawler, Danish and Scottish seines, and fixed gears (F.G.), 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 trawls and Danish seines from 1947 to 1963 (Powles 1969). Since 1965, gillnets have also been used (Table 1). Danish seines have taken an increasing proportion of the total landings since 1965 and are now the dominant gear type.

### Nominal Landings and Description of the Fishery in 1990

The nominal landings for 1990 were 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 the landings for 1990 was 5,614 t, up 600 t from the all-time low of 4987 t in 1989. Nominal landings, by gear and month, are presented in Table 2. Nominal landings of flatfish in the entire Gulf of St. Lawrence are shown in Table 3. The total flatfish landings in the Gulf for 1989 were approximately 2800 t lower than the 28 year average.

The progression of landings with time in the 1990 M.G. fishery was slightly faster than in 1989 (Figure 1). The F.G. fishery proceeded at a more steady pace than in 1989.

The proportion of NAFO Division 4T plaice landed by province during 1990 could not be calculated due to the lack of data. The proportion of Division 4T plaice landed in Quebec decreased from 38% of the total landings in 1988 to 34% in 1989 (Table 4, Figure 2). The Maritimes took virtually all of the remaining landings (65.6%). The proportion taken by Danish, Scottish and pair seines (M.G.) increased from 38% of the landings in 1988 to 46% in 1989 (Table 1). Landings by fixed gear (F.G.) decreased substantially from 1,370 t during 1988 to 759 t during 1989.

There have been no closures of the American plaice fishery in 4T since 1985 (Table 5). The M.G. (65-100'), (45-65') and (<45') fishermen caught substantially less than their allocations. The F.G. fishermen also caught less than their allocation of 1500 t. Closures in the cod fishery to protect young cod ( G. Chouinard, Gulf Fisheries Center, Moncton, N.B., pers. comm.) may have influenced the fishing patterns of American plaice fishermen 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. This latter problem was reported most frequently by 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 1988 and Chouinard *et al.* 1987). The results of age reader agreement tests 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 during 1990 was comparable to previous years. Samples were taken from May to November, representing over 97% of the landings. Over 15,000 fish were measured during 1990 ( Table 7) and, of these, ages were determined for 1,851 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) Danish and Scottish seines; and 3) gillnets and longlines. The unsampled landings were incorporated by

multiplying the landings at age for sampled gears by the ratio of the total landings over sampled landings.

All calculations of age-length keys and landings by gear within semi-annual periods were done separately for each sex. 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 its variance, by gear and semi-annual period, are presented in Tables 9 and 10. The variances are similar to those recorded in recent years.

The weights at age from 1976 to 1990 were determined using a length-weight relationship calculated from RV survey data for each year. The regressions for 1990 were ( $Y = .007107X^{3.0601}$ ) and ( $Y = .004486X^{3.2014}$ ) for the males and females respectively. The lengths and weights at age for 1990 by sex are shown in Tables 11 and 12.

A decline in the average length at age from the first half of 1990 to the second was observed in some age groups of both sexes in all gears. Tallman (1991) suggested that this was a result of the movement of the 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 Division 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 1991) is that the larger fish migrate into a winter refugium in the Laurentian Channel sooner than the smaller fish. Clay (1991) and Powles (1969) showed that the Channel is used by American plaice during the colder months (Table 12).

The combined landings at age for 1976 to 1990 are shown in Table 13. During 1990, fewer fish over age-13 were landed compared to 1989. The matrix shows some strong year classes apparently recruiting to the fishery in the late 1970's. During the 1980's, recruitment appears to be much less. This pattern continued for 1990, but landings show modest increases in some of the younger age groups. The coefficients of variation of the landings at age from 1976 to 1990 are shown in Table 14.

## 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 Kohler 1971). According to Clay (1979), this should retain 50 per cent of the plaice of 7 cm 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, the survey probably gives an unbiased estimate of the population size structure available to commercial gear (greater than 20 cm).

The methodology for estimating the discarded portion of the commercial catch is given in Tallman and Forest-Gallant (1990). The discards at age for 1976 to 1990 are shown in Table 15. As expected, 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 16. The age of full recruitment appears to be between ages 7 to 9 compared to 12 or 13 for the landings at age matrix. Weights at age for the catch including discards are shown in Table 17.

#### **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 plaice directed and cod directed fisheries are thought to change as a function of stock size. As well the "catch" recorded is the landings and not the true catch.

#### **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 was conducted during the 1985 survey to determine conversion factors. A constant trawlable unit size was used for both vessels. 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 using this conversion factor.

In addition to the change of survey vessels, a change was made to the survey design. From 1984 to 1986 the random stratified station design was replaced by a fixed survey with random initial allocation of stations. Since 1987, the random stratified survey design was used.

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 1971-1990 are shown in Figure 3. Mean numbers per tow at age are presented in Table 18. A conspicuous pattern in this matrix is the high mean numbers per tow for the late 1970s, presumably reflecting high abundance for this period. The numbers per tow for 1986, 1987, 1988 and 1989 are the lowest in the series. The 1990 mean number per tow is the highest since 1983. There was a large increase in the numbers captured between ages 2 and 6 in 1990 compared to the previous few years.

### ESTIMATION OF PARAMETERS

#### A) Mortality estimated from Survey data

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 during the 1980s than during the 1970s as indicated by averages in Table 20. Also the total mortalities at age increased to about age-8.  $Z$ 's were relatively constant after age-8 up to age-18. Estimates of abundance for older age groups were not used because sampling was limited. The average age 8 to 18 values of  $Z$  were 0.37 for 1971-79 and 0.54 for 1980-89.  $F_{0.1}$  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 coefficients of variation from the survey are shown in Table 21. These were calculated as per Tallman and Sinclair (1989). However, this method may be somewhat biased. A more appropriate method of calculating the variance with three sex groups would be to calculate the variance on the mean number per tow within each stratum and then take the weighted average across all strata.

RV mean number per tow for plus groups are shown in Table 22. The trends in  $Z$  at age were smoothed by calculating total mortalities from a matrix of plus groups (Table 23).

#### B) Fishable Biomass

Total biomass was estimated from the RV surveys from 1987 to 1990 by combining the biomass of the male, female, and juvenile 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 and older fish for the years 1987 to 1990 was estimated by combining the age-10+ biomass estimates of the males, females and juveniles (Table 24).

#### E) Estimation of Total Allowable Catch

We used total mortality estimates, dis-aggregated by age, to calculate biomass and thence a TAC. The estimated average fishing mortality for ages 8 to 18 is approximately 0.34. The abundance indices from both the RV survey and the commercial catch rates indicate relative stability in the population during the 1980s. The average landings over the same period (1981-90) were 7,242 t. We used the catch equations to estimate the biomass (B) as:

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

$$= 27,566 \text{ t}$$

where,

C = average landings (7,242 t)

Z = current total mortality (0.54)

assuming M = 0.2 then

F = current fishing mortality (0.34)

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

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

$$= 4,544 \text{ t}$$

$$F_{0.1} = 0.2$$

$$Z_{0.1} = 0.4$$

We consider the result to be reasonably precise because the RV survey catch has relatively low coefficients of variation at most ages (Table 21). However, this estimate is made with the assumption that biomass has been relatively stable in the recent past, the age structure remains stable, recruitment has been stable and there have been no changes in the partial recruitment. An additional assumption is that the pattern of discarding does not change with time.

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 to 1990, the projected yield is 3,433 t.

### Juvenile Areas

One of the conservation measures that can be used to protect fishery resources is the closure of areas where juveniles are abundant. To investigate this, we combined the data from the annual RV abundance surveys from 1971 to 1989 and plotted the distribution for ages 1 through 10 in Figure 4. The distribution shows a distinct pattern. Two centers of distribution were identified: a major settling area in the Baie des Chaleurs and a lesser one between Prince Edward Island and Cape Breton Island. With increasing age, the distribution spreads from these points to a relatively even distribution throughout the Magdalen Shallows by ages 9 and 10. Figures 5 and 6 show that the distribution of juveniles is confined to a limited number of strata. Strata 418, 419 and 434 were the most important for the youngest ages (Figure 7). Strata 422 was important for ages 3 and older. We used SAS PROC GCONTOUR to give a plot of the expected densities by latitude and longitude of ages 1 to 10. Two clear foci are apparent for ages 1 to 3, one in the Baie des Chaleurs and one between Cape Breton I. and P.E.I. (Figure 8). The pattern gradually diffuses until, by ages 9 and 10 the two groups have joined to cover the Magdalen Shallows. The 1990 RV data revealed a similar overall pattern (Figure 9, Tables 25 to 28). However, the highest catches of age 2 plaice were in stratum 422 which lies due east of the Acadian Peninsula.

### PROGNOSIS

The survey mean number per tow in 1990 shows improvement in the stock numbers, mainly due to increases in the younger ages. Estimates of  $F$  indicate levels in excess of  $F_{0.1}$ . The status quo projection suggests that fishing at  $F_{0.1}$  would require a reduction in the TAC to below 5000 t. Fifteen per cent of the fishable biomass suggests a lower TAC of about 3,433 t. Given the concordance of all the indices, a more appropriate TAC for this stock 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 being realized from the reduction in landings.

## ACKNOWLEDGEMENTS

The authors wish to thank G. Chouinard, D. Clay, G. Neilson, M. Hanson and D. Swain of the Department of Fisheries and Oceans, Moncton for their helpful advice and criticism of the manuscript.

## 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.
- 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. 1991. Seasonal distribution of demersal fish (Osteichthyes) and skates (Chondrichthyes) in the southeastern Gulf of St. Lawrence. IN: J.C. Therriault (Ed.) The Gulf of St. Lawrence: Small ocean or big estuary? Can. Fish. Aquat. Sci. Special Publication 113: 241-259.
- 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. Metzals 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.
- Powles, P.M. 1969. Size changes, mortality, and equilibrium yields in an exploited stock of American plaice (Hippoglossoides platessoides). J. Fishes 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.

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. and I. Forest-Gallant. 1990. Assessment of American plaice, Hippoglossoides platessoides, in NAFO Division 4T. C.A.F.S.A.C. Res. Doc. 90/66.

Tallman, R.F. 1991. Causes of within-season decline in size at age of American plaice, Hippoglossoides platessoides. IN: J.C. Therriault (Ed.) The Gulf of St. Lawrence: Small ocean or big estuary? Can. Fish. Aquat. Sci. Special Publication 113: 269-275.

Table 1. Nominal landings (t) of 4T American plaice from 1965-1990 by major gear types.

YEAR	OTB	OTB-1	OTB-2	SNU	GN	LL	LHP	OTHERS	TOTAL	TAC
1965	7782	-	-	1854	388	212	-	149	10385	---
1966	-	8086	581	2322	375	2	-	434	11780	---
1967	-	7237	211	1151	328	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	-	4896	409	2885	876	21	9	317	9513	---
1972	14	4275	860	2578	266	73	11	199	8294	---
1973	20	3087	471	2748	241	73	1	408	7047	---
1974	0	3556	585	3719	250	6	5	364	8485	---
1975	1	3207	795	3697	217	14	16	294	8443	---
1976	41	4097	2864	3395	225	2	6	562	11192	---
1977	35	4261	375	4015	242	16	17	359	9320	10000
1978	58	3651	889	3495	379	42	38	479	9031	10000
1979	83	3415	961	3719	721	9	17	1161	10086	10000
1980	1485	1609	558	3500	717	55	5	163	8292	10000
1981	1022	1311	290	3575	1084	96	2	452	7834	10000
1982	742	580	137	4124	805	94	5	55	6542	10000
1983	821	479	102	4095	494	76	10	17	6094	10000
1984	235	601	2582	3702	1905	386	25	191	9627	10000
1985	165	824	3027	3870	1007	404	29	164	9490	10000
1986	74	768	2125	3089	640	308	44	127	7175	10000
1987	50	1075	2101	3140	831	664	67	136	8064	10000
1988	15	540	2002	2842	957	484	33	116	6989	10000
1989*	-	498	1433	2271	548	190	21	26	4987	10000
1990*	-	733	1321	2469	658	323	10	100	5614	10000
AVERAGE	487	3014	993	2963	590	146	19	273	8484	

\*(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. Preliminary landings (t) of American plaice for 1990 by gear and month.

GEAR	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
OTB1	-	-	-	11.8	109.6	86.7	59.2	84.8	81.5	214.1	85.3	0.0	733.0
OTB2	0.3	0.0	0.1	8.9	87.5	169.8	304.7	244.3	189.1	180.3	125.3	0.9	1321.2
OTM2	-	0.5	-	-	0.2	0.0	0.0	-	0.0	0.0	-	-	0.7
PTB	-	-	-	-	0.1	-	-	2.0	0.0	1.0	1.0	-	4.1
TXS	0.0	-	0.0	0.7	28.4	5.8	9.2	7.6	11.1	14.0	1.5	-	78.3
SDN	-	-	0.1	65.4	268.7	309.8	287.6	236.3	265.5	207.9	198.1	1.0	1840.4
SSC	-	-	-	17.0	37.0	94.4	131.8	68.6	43.9	35.1	44.4	-	492.2
SPR	-	-	-	0.8	9.2	34.2	41.0	31.1	10.2	9.7	0.0	-	136.1
GNS	0.0	0.0	0.0	20.9	55.8	139.6	132.8	112.12	127.2	39.2	20.5	10.1	658.2
LLS	-	-	-	0.0	3.2	16.6	80.5	84.0	50.7	30.2	20.6	9.0	296.8
LHP	-	-	-	-	0.0	0.2	5.7	0.9	1.6	1.2	0.4	-	10.0
LHB	0.0	0.0	0.0	-	4.2	3.2	5.1	6.3	4.2	2.5	0.2	-	25.7
FPN	0.1	0.2	0.0	-	0.0	3.2	3.4	1.5	4.3	3.1	-	0.2	16.9
TOT	0.4	0.7	0.2	125.5	603.9	863.5	1061.0	899.5	789.3	750.3	497.3	21.2	5613.6

\* Values of 0 indicate landings of less than 50 Kg.

- Indicate 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(2 boats), GNS= gillnet set LLS= set lines, LHP= handlines, LHB= handlines with bait, FPN= uncovered pound nets. FWR= weirs, 66= , RT= rakes and tongs.)

Table 3. Commercial flatfish nominal landings (t) in NAFO Division 4RST from 1963 to 1990

YEAR	YELLOW ATLANTIC TAIL	GREEN. HALIBUT	HALIBUT	WITCH	WINTER FLOUNDER	AMER. PLAICE	UNSPEC. FLOUNDER	TOTAL FLATFISH
1963	107	537	-	4250	3165	8470	-	18529
1964	85	615	-	3350	3014	8803	9	15858
1965	53	893	24	3808	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	288	510	802	4763	1710	10978	-	19031
1970	59	509	1112	4605	2694	13234	-	22413
1971	40	454	954	3821	2642	11770	-	19861
1972	3	310	683	2001	1911	9724	1373	16005
1973	6	385	763	2224	2394	8149	2426	16337
1974	27	418	1011	3247	1976	11261	999	16939
1975	3	272	1544	2722	2050	10177	3951	20719
1976	37	196	2019	6675	2471	14265	1785	27846
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	409	261	11069	2609	2808	10409	-	27565
1988	215	238	7583	2530	1847	8980	-	21393
1989*	49	253	5122	2206	2596	6720	-	16946
1990*	87	503	2767	1769	2581	6940	-	14647
AVERAGE	93	332	2873	3049	2251	10518	632	19748

(\* PROVISIONAL DATA)

Table 4. The 1989 provisional flatfish nominal landings (t) in the Gulf of St. Lawrence by NAFO division and province.

COUNTRY CODE	YELLOW ATLANTIC TAIL	GREENLAND HALIBUT	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	406.5	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 1987-1990 (M.G.=mobile gear, F.G.=fixed gear).

YEAR	GEAR	FINAL ALLOCATIONS (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	1509	none
	M.G (less than 45)	4200	2460	none
	F.G (less than 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 (less than 45)	4200	1829	none
	F.G (less than 65)	1500	752	none

Table 6. Age reader tests on otoliths read from 1990 RV sampling and commercial fishery (+ or - indicates bias).

Date (1991)	Comparison (X agreement)	skewness	Comments
Reader vs reference			
JAN 28	82	-0.59508	NO SKEWNESS
FEB 13	84	-1.42039	NO SKEWNESS
MAR 1	82	-0.88372*	RE-TEST
MAR 4	83	0.071068	NO SKEWNESS
MAR 13	78	-0.21011	NO SKEWNESS
MAR 25	89	-0.56783	NO SKEWNESS

\* significant skewness (bias)

TABLE 7. NUMBERS MEASURED AND AGED FOR 4T AMERICAN PLAICE IN 1990

		MAY	JUN	JUL	AUG	SEP	OCT	NOV	TOTAL
GEAR									
LONG-LINE	SIZED	.	252	179	507	.	.	.	938
	AGED	.	36	30	56	.	.	.	122
SEINE	SIZED	598	1938	2526	1448	1634	1874	147	10165
	AGED	86	250	257	200	177	233	18	1221
TRAWL	SIZED	339	518	613	526	474	1477	.	3947
	AGED	47	63	76	64	59	199	.	508
Total number of samples		5	11	13	10	9	14	1	63



Table 2. Age-length table used in the calculation for 1990 catch at age  
 "a" and "b" are the coefficients of the length-weight relationship.

YEAR	TABLE TYPE	GEARS	PERIOD		SAMPLE SIZE	CATCH (t)
1990	ALK	ALL GEARS	JAN-JULY	LENGTH AGED	6963 845	2655
	ALK	ALL GEARS	AUG-DEC	LENGTH AGED	8087 1006	2958
	LF	(11,12,15,16)	JAN-JULY	LENGTH	1470	839.4
	LF	(21,22,23)	JAN-JULY	LENGTH	8062	1297
	LF	(41,50,51,53,59)	JAN-JULY	LENGTH	431	467.8
	LF	(11,12,16)	AUG-DEC	LENGTH	2477	1219.6
	LF	(21,22,23)	AUG-DEC	LENGTH	5103	1171.8
	LF	(41,50,51,53,59)	AUG-DEC	LENGTH	507	2213.8

(Gear types: 10=Otter trawl, 11=Otter trawl-side, 12=Otter trawl-stern,  
 15=Midwater trawl (stern), 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, 53=Handlines, 59=Handlines with bait.)

Table 9. Landings at age ('000's) of NAFO Division 4T American Plaice by gear and season for 1990

AGE	JAN-JULY			JAN-JULY			TOTAL CATCH	WEIGHTED CATCH
	TRAWLS	SEINES	GN&LL	TRAWLS	SEINES	GN&LL		
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	0.180	0.305	0.000	0.167	338.481	0.000	339.13	344.93
5	4.085	1.182	0.000	6.206	137.923	0.022	149.42	151.97
6	107.920	34.955	0.246	52.908	235.758	0.319	432.11	439.49
7	139.860	50.184	0.835	194.861	337.937	2.762	726.44	738.85
8	460.661	151.870	3.482	365.653	586.142	8.532	1576.34	1603.28
9	435.964	200.157	7.784	302.141	396.391	7.394	1350.43	1373.51
10	336.309	169.828	10.979	399.282	450.033	19.633	1386.06	1409.75
11	255.941	150.122	14.662	230.708	229.807	16.639	897.88	913.22
12	153.681	171.150	24.527	137.911	116.706	12.394	616.37	626.90
13	145.017	149.894	28.057	149.627	107.727	23.985	604.41	614.74
14	63.670	123.098	31.818	108.108	67.592	24.409	418.70	425.85
15	58.309	119.153	38.645	84.172	44.128	21.709	366.12	372.37
16	19.677	99.425	42.524	63.659	39.688	18.589	283.56	288.41
17	13.500	93.310	38.448	35.685	17.872	15.317	214.13	217.79
18	4.145	53.283	23.449	29.843	13.851	15.739	140.31	142.71
19	0.376	55.596	32.486	21.723	8.698	8.417	127.30	129.47
20	0.136	15.116	13.690	6.205	2.230	3.725	41.10	41.80
21	0.144	21.834	14.507	4.892	2.225	3.751	47.35	48.16
22	0.033	3.904	6.310	1.756	1.154	1.840	15.00	15.25
23	0.046	4.625	5.297	0.120	0.261	0.209	10.56	10.74
24	0.007	3.510	1.202	0.000	0.125	0.000	4.84	4.93
25	0.000	0.170	0.000	0.444	0.263	0.341	1.22	1.24

Table 10. Variance at age of estimated landings of NAFO Division 4T American Plaice by gear and season for 1990.

AGE	JAN-JULY			JAN-JULY			TOTAL
	TRAWLS	SEINES	GN&LL	TRAWLS	SEINES	GN&LL	
1	0.00	0.000	0.000	0.00	0.00	0.000	0.00
2	0.00	0.000	0.000	0.00	0.00	0.000	0.00
3	0.00	0.000	0.000	0.00	0.00	0.000	0.00
4	0.08	0.100	0.000	0.07	622.41	0.000	622.66
5	0.38	0.456	0.000	14.61	323.78	0.001	339.23
6	729.92	70.185	0.036	228.94	1985.70	0.027	3014.81
7	1016.78	124.232	0.189	813.74	2025.62	0.458	3981.02
8	2752.05	350.016	1.717	1277.33	3420.71	2.059	7803.88
9	2682.08	508.774	2.995	1140.17	2227.94	1.939	6563.90
10	2097.99	428.401	5.452	1338.55	2179.27	6.277	6055.93
11	1535.57	373.843	10.145	760.73	1036.06	5.931	3722.28
12	629.61	404.617	18.703	378.84	450.59	4.711	1887.06
13	919.28	379.323	28.232	345.65	279.44	9.483	1961.40
14	180.10	304.880	31.600	231.65	181.10	10.177	939.50
15	283.88	303.666	40.832	156.19	84.18	9.670	858.41
16	38.59	217.222	43.791	140.65	122.82	8.272	571.35
17	17.79	236.552	47.459	52.95	17.46	7.084	379.29
18	3.54	152.399	30.761	34.07	8.66	7.615	237.05
19	0.08	154.637	45.404	26.98	4.59	3.399	235.09
20	0.03	38.694	20.318	6.69	0.79	2.069	68.59
21	0.02	48.689	21.905	4.00	0.65	1.673	76.93
22	0.01	4.516	9.374	0.99	0.40	0.912	16.19
23	0.01	6.582	7.948	0.03	0.07	0.053	14.68
24	0.00	7.883	1.240	0.00	0.02	0.000	9.15
25	0.00	0.000	0.000	0.16	0.05	0.075	0.28

TABLE 11. AVERAGE WEIGHT (kg) AT AGE OF NAFO DIVISION 4T  
AMERICAN PLAICE BY GEAR AND SEASON FOR 1990.

-----SEX-MALES-----						
AGE	JAN-JULY			AUG-DEC		
	TRAWLS	SEINES	GN&LL	TRAWLS	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	0.1906	0.1906	0.0000	0.0000	0.0582	0.0000
5	0.1919	0.2122	0.0000	0.1519	0.1037	0.0000
6	0.3281	0.2424	0.0000	0.3151	0.1225	0.0000
7	0.2820	0.2717	0.0000	0.3606	0.2010	0.4113
8	0.2975	0.3207	0.3453	0.3143	0.2312	0.4810
9	0.3083	0.3173	0.5188	0.3306	0.2893	0.4288
10	0.3037	0.3348	0.5216	0.3402	0.2901	0.5835
11	0.3238	0.3981	0.8028	0.3307	0.2713	0.4847
12	0.3248	0.3848	0.5827	0.3709	0.2883	0.4296
13	0.3128	0.4070	1.0335	0.3574	0.2926	0.8673
14	0.3614	0.4288	0.7084	0.4034	0.3592	0.6319
15	0.3725	0.5023	1.0511	0.4225	0.3479	0.6747
16	0.5605	0.5955	0.6592	0.4653	0.7862	0.4853
17	0.5677	0.5999	0.8707	0.8211	0.5683	0.5254
18	0.8141	0.8141	0.0000	0.0000	0.0000	0.0000
19	0.0000	1.0565	0.0000	0.4472	0.4472	0.0000
20	0.0000	1.8650	0.0000	0.0000	0.0000	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

-----SEX-FEMALES-----						
AGE	JAN-JULY			AUG-DEC		
	TRAWLS	SEINES	GN&LL	TRAWLS	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	0.1927	0.1055	0.0000
5	0.1032	0.1538	0.0000	0.2732	0.1903	0.2669
6	0.2906	0.3136	0.3603	0.3369	0.2317	0.3700
7	0.3318	0.3843	0.5328	0.3914	0.3496	0.5017
8	0.3369	0.3800	0.7115	0.4291	0.3702	0.6163
9	0.3976	0.4640	0.6752	0.4367	0.3975	0.6600
10	0.4264	0.5506	0.7628	0.5048	0.4506	0.7325
11	0.4641	0.6131	0.9721	0.5707	0.5088	0.8281
12	0.5290	0.7290	1.0921	0.8231	0.5492	0.8388
13	0.4875	0.6090	1.2074	0.7394	0.6767	0.9135
14	0.5878	0.9570	1.2341	0.8600	0.7537	1.0633
15	0.5424	1.0242	1.4322	0.9473	0.6860	1.1254
16	0.6550	1.1168	1.4057	0.9273	0.8201	1.1673
17	0.7703	1.2526	1.4630	1.1579	1.1084	1.3418
18	0.8247	1.2703	1.5091	1.2836	1.2868	1.3779
19	1.4475	1.5250	1.6588	1.2539	1.3002	1.3885
20	1.7059	1.6360	1.9348	1.4108	1.5429	1.4651
21	1.4748	1.6283	1.7069	1.6698	1.6277	1.8055
22	1.9629	2.1877	2.2864	1.7111	1.7071	1.7309
23	2.0493	1.9129	1.9347	2.2102	2.4345	2.2102
24	1.7722	1.9369	1.8449	0.0000	2.9071	0.0000
25	0.0000	3.2769	0.0000	2.0442	2.1067	2.1224

TABLE 12. AVERAGE LENGTH (cm) AT AGE OF NAFO DIVISION 4T AMERICAN  
PLAICE BY GEAR AND SEASON FOR 1990.

-----SEX-MALES-----						
AGE	JAN-JULY			AUG-DEC		
	TRAWLS	SEINES	GN&LL	TRAWLS	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	28.0000	28.0000	0.0000	0.0000	19.0000	0.0000
5	27.8671	29.0000	0.0000	26.0000	22.7600	0.0000
6	33.2132	30.0986	0.0000	33.0000	23.5401	0.0000
7	31.7111	31.2031	0.0000	34.2115	28.0029	36.0000
8	32.1967	33.0013	34.0000	32.8229	29.5471	37.8260
9	32.6736	32.7277	38.3652	33.3843	31.9529	36.4190
10	32.5070	33.3414	38.3714	33.6137	31.9329	39.9063
11	33.1652	35.2388	44.3394	33.3029	31.1750	37.3945
12	33.1598	34.1705	39.8846	34.5661	31.7536	36.4533
13	32.7412	35.2689	48.4277	34.0265	31.8681	41.8617
14	34.1792	36.0315	43.0000	35.3858	34.1975	41.2598
15	34.7239	37.8379	48.7412	35.8212	33.8881	42.1338
16	39.7930	40.5801	42.0000	38.0000	43.9408	38.0000
17	40.0000	40.6365	46.0000	41.0920	39.9367	39.0000
18	45.0000	45.0000	0.0000	0.0000	0.0000	0.0000
19	0.0000	49.0000	0.0000	37.0000	37.0000	0.0000
20	0.0000	59.0000	0.0000	0.0000	0.0000	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

-----SEX-FEMALES-----						
AGE	JAN-JULY			AUG-DEC		
	TRAWLS	SEINES	GN&LL	TRAWLS	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	28.0000	22.9945	0.0000
5	22.8115	25.7206	0.0000	31.1925	27.6895	31.0000
6	31.7448	32.3739	33.7648	33.2035	29.1309	34.2284
7	33.0565	34.3593	37.9833	34.7374	33.5161	37.4784
8	33.1936	34.2991	41.1124	35.6803	34.0214	39.7452
9	34.9263	36.5596	40.9819	35.8999	34.9131	40.5460
10	35.5784	38.4710	42.6820	37.4977	36.2058	42.0373
11	36.5774	39.5997	45.8047	38.8858	37.5561	43.6351
12	38.0679	41.6878	47.3952	39.9415	38.3618	43.9321
13	36.9513	42.8832	49.0870	42.1885	41.0153	45.0933
14	39.3422	45.3021	49.5625	44.0733	42.1413	47.3310
15	38.2778	46.1889	51.6582	45.5389	44.5193	48.1805
16	40.5779	47.7858	51.5355	45.0282	43.0333	48.8902
17	42.9635	49.6547	52.3346	48.4284	47.6629	50.9312
18	43.7977	50.0239	52.6800	50.3389	50.2905	51.4797
19	52.1815	53.2245	54.5429	49.9615	50.3781	51.5284
20	55.2093	54.4919	57.2289	52.1020	53.4013	52.7135
21	52.6245	54.2858	55.1466	54.7336	56.3172	56.1376
22	58.0000	59.7433	60.5598	55.3197	55.2541	55.4871
23	58.5844	57.3449	57.5384	60.0000	61.7684	60.0000
24	56.0000	57.4656	56.6395	0.0000	65.2204	0.0000
25	0.0000	67.8517	0.0000	56.5398	59.1067	59.2278

Table 13. ESTIMATED LANDINGS AT AGE (,000) for 4T Plaice from 1976 to 1990

AGE	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
1	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
3	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
5	37	99	242	0	0	0	0	128	195	89	25	48	60	93	152
6	457	801	776	473	81	41	25	177	358	92	397	139	232	361	440
7	1380	2101	2002	1202	615	190	46	286	798	464	769	483	234	921	739
8	2371	2253	3637	4682	1129	461	378	417	782	680	1322	527	484	1119	1603
9	2142	1884	2671	5723	2771	717	1061	529	960	728	1349	574	768	1531	1374
10	2400	1625	2612	3926	2640	1564	1682	843	1557	1161	1193	794	739	1018	1409
11	2036	1295	2144	2379	2279	1190	1482	1107	1823	1664	1505	784	822	828	913
12	2818	1706	1470	1534	2722	1417	1489	1454	1628	2098	1677	868	980	669	627
13	1466	902	1383	1051	2322	944	1027	1476	1009	1789	1572	1094	800	577	615
14	796	594	720	988	1663	1314	735	873	1299	1560	1016	984	968	443	426
15	397	289	542	309	1586	2047	413	600	883	1112	798	958	828	391	372
16	407	231	144	209	713	949	324	468	459	817	551	699	789	352	288
17	334	201	102	127	462	1286	34	447	580	531	329	664	433	243	218
18	207	237	109	28	97	803	255	297	378	258	179	337	368	200	143
19	267	157	86	57	106	203	43	338	267	297	182	315	232	86	130
20	165	171	33	44	133	280	24	115	197	138	136	295	205	88	42
21	98	44	95	71	39	221	73	74	57	70	119	164	81	56	48
22	75	20	0	17	0	0	35	105	24	60	34	118	73	31	15
23	26	10	113	7	0	0	27	17	18	28	25	87	47	18	11
24	14	17	29	0	0	0	11	3	0	15	18	45	50	6	5
25	11	0	0	14	0	0	6	16	0	20	6	24	24	6	1
26	6	14	15	0	0	0	2	11	0	0	6	26	0	3	0
TOTAL	17921	14822	19124	22843	19358	13627	9488	9786	13296	13669	13188	10028	9240	9071	9917

Table 14. CV's (/100) FOR LANDINGS OF 4T PLAICE FROM 1976 TO 1990.

AGE	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
4	0.000	0.000	0.000	0.000	0.000	0.847	0.000	0.000	0.126	0.198	0	0.000	0.043	0.030	0.044
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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	0.032
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
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
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
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
25	0.353	0.000	0.000	0.586	0.000	0.597	0.769	0.711	0.000	0.815	0.271	0.211	0.504	0.036	0.025
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

Table 15. NAFO Division 4T American plaice discards at age ('000) for 1978 to 1990.

AGE	YEAR														
	1978	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
1	0	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	11
3	0	0	0	0	0	0	0	0	69	0	68	0	0	124	6
4	1521	322	217	98	179	166	32	168	217	444	716	159	115	399	368
5	14303	4445	1318	722	951	384	738	1022	610	1663	1370	1539	893	2396	2731
6	29268	12192	3648	2983	2714	2683	1300	3235	1560	2146	3107	5968	4000	4718	5327
7	19802	17997	8130	6894	7424	5861	3219	3629	2854	2832	4622	8971	3954	10080	5450
8	9635	9249	5623	7202	9572	7505	6754	7089	3446	3832	3313	8673	5826	8273	6801
9	8262	3395	1711	3141	4825	7083	5742	10589	4825	3177	3227	7708	3995	6866	4054
10	5020	1840	979	1094	1942	4925	4287	7758	6018	3138	1868	8370	1862	4972	2730
11	2524	791	368	438	489	2185	1458	8142	2531	3750	2334	5410	1452	2565	1822
12	953	385	59	158	157	997	202	4494	2371	2935	3703	4618	1224	2341	876
13	0	103	27	45	75	104	8	1037	1010	2211	2253	2134	1011	1571	647
14	223	0	0	12	27	75	0	278	223	1746	1840	1753	971	1066	122
15	49	23	0	1	0	150	14	93	39	615	874	911	328	548	172
16	0	8	0	0	0	0	0	0	0	300	584	474	47	220	12
17	30	0	0	0	0	0	0	38	11	139	268	142	40	108	3
18	0	0	0	0	0	0	0	0	0	109	23	0	3	4	0
19	0	0	0	0	0	0	0	0	0	39	43	0	0	0	6
20	0	0	0	0	0	0	0	0	0	19	0	0	0	0	0
21	0	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	0
23	0	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	0
25	0	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	0
TOTAL	91590	50550	22298	22788	28335	32057	23754	48597	25584	29093	30013	54830	25721	46252	31138

Table 16. NAFO Division 4T Catch at age ('000) including discards for 1976 to 1990.

AGE	YEAR														
	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
1	0	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	11
3	0	0	0	0	0	0	0	0	69	0	68	0	0	124	6
4	1521	325	226	100	179	166	32	172	263	462	716	160	138	410	713
5	14340	4544	1560	722	951	384	738	1150	805	1752	1395	1587	953	2489	2883
6	29725	12793	4422	3456	2795	2704	1325	3412	1916	2238	3504	6107	4232	5099	5767
7	21182	20098	10132	8096	8039	6051	3265	3915	3652	3296	5391	9454	4188	11001	6189
8	12006	11502	9660	11884	10701	7966	7132	7506	4228	4512	4635	9200	6310	9392	8404
9	10404	5279	4382	8864	7596	7780	6803	11098	5585	3905	4576	8282	4763	8397	5428
10	7420	3265	3591	5020	4582	6489	5969	6601	7575	4297	3061	7164	2601	5990	4139
11	4560	2086	2532	2817	2748	3355	2940	10249	4354	5414	3839	6194	2274	3393	2735
12	3771	2091	1529	1692	2879	2414	1891	5948	3999	5033	5380	5486	2204	3010	1503
13	1466	1005	1410	1096	2397	1047	1035	2513	2019	3980	3825	3228	1811	2148	1262
14	992	594	720	1000	1690	1389	735	1151	1522	3306	2856	2737	1939	1509	548
15	446	312	542	310	1586	2197	427	693	922	1727	1672	1869	1156	940	544
16	407	239	144	209	713	949	324	468	459	1117	1135	1173	836	572	300
17	364	201	102	127	462	1286	34	483	571	670	597	806	473	351	221
18	207	237	109	28	97	803	255	297	378	367	202	337	371	204	143
19	267	157	66	57	106	203	43	338	267	336	205	315	232	86	136
20	165	171	33	44	133	280	24	115	197	157	136	295	205	88	42
21	98	44	95	71	39	221	73	74	57	70	119	164	81	56	48
22	75	20	0	17	0	0	35	105	24	60	34	118	73	31	15
23	26	10	113	7	0	0	27	17	18	28	25	87	47	18	11
24	14	17	29	32	0	0	11	3	0	15	18	45	50	6	5
25	11	0	0	14	0	0	6	16	0	20	6	24	24	6	1
26	6	14	15	0	0	0	2	11	0	0	6	26	0	3	0
TOTAL	109473	65004	41412	45663	47693	45684	32926	58382	38880	42762	43201	64858	34961	55323	41054

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

AGE	YEAR														
	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2	.	.	.	.	.	.	.	0.355	.	.	.	.	.	.	0.160
3	.	.	.	.	.	.	.	.	0.182	0.110	0.248	.	.	0.218	0.141
4	0.110	0.118	0.138	0.171	0.189	0.182	0.144	0.128	0.152	0.201	0.209	0.146	0.167	0.190	0.150
5	0.147	0.138	0.145	0.123	0.160	0.196	0.186	0.169	0.170	0.205	0.209	0.156	0.200	0.211	0.204
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	0.219
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	0.264
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	0.286
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	0.282	0.314
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	0.359
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	0.380
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	0.453
13	0.722	0.474	0.335	0.410	0.453	0.447	0.533	0.346	0.370	0.291	0.305	0.393	0.369	0.309	0.517
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	0.750
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	0.756
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	1.010
17	0.468	1.854	0.882	1.605	1.046	1.101	1.240	0.467	0.577	0.251	0.358	0.321	0.531	0.396	1.205
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	1.271
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	1.419
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	1.639
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	1.615
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	1.990
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	1.922
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	1.940
25	0.354	.	.	2.124	.	1.789	2.100	2.032	.	2.471	1.728	1.928	1.896	2.273	1.937
26	2.251	1.897	2.849	.	.	2.161	2.748	1.820	.	.	2.387	1.907	.	2.449	.

Table 18. NAFO Division 4T plaice R.V. mean catch (numbers) per tow adjusted (Prince\*1.8)

AGE	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
1	1.24	1.04	0.88	0.82	0.46	0.00	0.71	0.00	0.08	2.64
2	8.41	8.16	7.14	16.56	4.56	5.23	5.63	1.30	1.37	7.13
3	26.07	14.66	23.35	57.59	22.79	52.49	80.11	10.26	6.81	35.17
4	43.52	33.63	32.56	116.32	65.16	175.19	228.75	83.33	66.07	80.13
5	41.88	32.68	37.79	97.87	159.00	257.07	312.34	110.19	181.36	90.62
6	43.55	36.62	29.36	80.00	81.14	202.69	183.02	122.79	163.86	113.05
7	45.03	42.02	24.69	52.60	62.77	96.91	121.98	113.10	184.15	79.65
8	27.44	28.91	27.33	40.63	39.77	42.43	53.74	74.98	138.53	64.02
9	9.50	13.15	21.39	45.37	28.44	38.05	21.81	24.63	63.76	33.11
10	8.65	7.74	9.52	27.72	19.18	26.51	14.85	15.92	32.66	17.42
11	5.89	3.67	5.05	12.39	14.70	17.88	8.67	8.39	18.31	10.55
12	3.79	3.53	3.87	4.04	4.31	11.82	5.93	4.27	9.89	5.84
13	2.78	1.83	3.16	3.37	2.40	7.03	3.88	4.67	6.05	4.10
14	2.36	1.17	3.58	3.42	1.85	3.85	2.13	1.53	5.57	2.15
15	1.45	0.51	1.94	2.44	1.11	1.58	1.19	1.41	2.94	0.90
16	1.22	0.64	1.48	1.24	1.07	1.37	0.32	0.55	2.14	0.46
17	1.07	0.16	1.34	0.80	0.15	1.44	0.44	0.32	0.53	0.36
18	0.47	0.16	0.59	0.54	1.09	0.55	0.13	0.14	0.69	0.11
19	0.12	0.06	1.85	0.17	0.58	0.04	0.60	0.14	0.38	0.14
20+	0.36	0.06	1.68	0.35	0.92	0.66	0.12	0.28	1.01	0.18
1+	272.80	230.40	238.35	564.04	531.47	942.59	1045.95	578.20	886.36	547.73

AGE	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
1	2.76	1.69	2.94	0.22	1.36	3.76	0.49	0.79	0.75	0.88
2	14.65	13.81	11.96	2.78	6.66	3.72	5.54	4.16	4.34	14.90
3	29.90	14.49	29.46	5.13	17.39	13.24	12.88	16.39	12.15	34.94
4	72.80	18.18	35.37	23.95	22.11	32.01	24.31	28.29	26.98	56.68
5	97.81	34.73	43.37	32.29	41.75	28.52	36.39	34.54	37.40	78.69
6	115.73	30.03	42.15	30.48	37.40	43.28	31.70	53.86	28.32	59.62
7	125.42	44.95	31.36	27.54	27.01	26.82	32.47	34.18	31.17	30.83
8	72.78	61.72	50.35	25.84	20.37	15.55	19.41	32.50	20.53	29.08
9	49.09	32.29	47.79	23.77	17.54	10.52	16.63	19.72	12.86	16.37
10	25.68	21.50	27.65	28.18	13.12	6.66	10.35	9.65	8.83	10.57
11	11.67	9.06	27.48	10.46	17.89	8.90	7.82	6.99	4.53	7.42
12	5.65	3.98	14.04	8.97	18.47	13.98	7.30	5.81	4.23	3.42
13	3.25	2.05	5.85	4.23	15.31	9.54	2.52	5.39	3.13	2.74
14	2.04	2.21	2.86	1.60	7.78	11.04	2.97	4.51	2.25	1.16
15	1.47	1.24	2.28	1.61	3.19	3.82	1.22	2.39	1.37	1.32
16	1.29	1.25	1.23	0.65	2.99	2.34	0.68	1.02	0.77	0.59
17	0.42	0.86	1.22	0.55	2.08	2.45	0.60	1.25	0.63	0.24
18	0.17	0.39	0.90	0.53	1.60	2.61	0.43	0.36	0.22	0.18
19	0.36	0.51	0.33	0.41	0.73	0.60	0.41	0.34	0.21	0.12
20	0.38	0.44	0.58	0.61	2.42	2.34	0.55	0.68	0.32	0.16
1+	633.32	295.48	379.17	229.80	277.17	241.70	214.64	262.81	200.99	349.91



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

AGE	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
1	-1.880	-1.928	-2.932	-1.721	-2.379	.000	-.604	.000	-4.479	-1.712
2	-.556	-1.052	-2.088	-.319	-2.438	-2.729	-.601	-1.658	-3.246	-1.434
3	-.255	-.798	-1.606	-.391	-2.040	-1.472	-.039	-1.862	-2.465	-.727
4	.286	-.116	-1.100	-.313	-1.105	-.578	.730	-.778	-.316	-.199
5	.134	.107	-.750	.187	-.243	.340	.934	-.397	.473	-.245
6	.036	.394	.583	.243	-.178	.508	.481	-.405	.721	-.104
7	.443	.430	.498	.280	.391	.589	.487	-.203	1.057	.090
8	.736	.302	-.507	.357	.044	.665	.780	.162	1.431	.266
9	.205	.323	-.259	.862	.070	.954	.315	-.288	1.298	.254
10	.595	.427	-.264	.634	.069	1.118	.557	-.140	1.136	.401
11	.513	-.054	.223	1.057	.218	1.104	.708	-.185	1.143	.624
12	.725	.108	.139	.520	-.491	1.167	.136	-.347	.881	.585
13	.864	-.670	-.076	.597	-.421	1.194	.876	-.177	1.036	.697
14	1.525	-.503	.385	1.127	.157	1.123	.411	-.657	1.821	.377
15	.812	-1.057	.445	.821	-.217	1.588	.778	-.416	1.867	-.362
16	2.037	-.736	.896	2.132	-.292	1.129	.002	.038	1.781	.090
17	1.871	-1.309	.921	-.588	-1.311	2.404	1.188	-.752	1.547	.754
18	2.142	-2.305	1.229	-.072	3.217	-.086	-.084	-1.026	1.573	-1.160
19	.761	-3.420	1.539	-1.872	-.136	-.999	.758	-1.971	.769	-.970

AGE	1981	1982	1983	1984	1985	1986	1987	1988	1989
1	-1.611	-1.960	.056	-3.427	-1.005	-.438	-2.139	-1.704	-2.989
2	.011	-.757	.846	-1.833	-.687	-1.148	-1.085	-1.072	-2.086
3	.487	-.893	.207	-1.460	-.610	-.566	-.787	-.498	-1.540
4	.740	-.869	.091	-.556	-.253	.057	-.351	-.279	-1.070
5	1.181	-.193	.353	-.147	-.036	-.098	-.392	.199	-0.466
6	.946	-.043	.425	.121	.332	.270	-.025	.547	-0.085
7	.709	-.113	.194	.302	.552	.543	-.001	.510	0.069
8	.813	.256	.751	.388	.661	.253	-.015	.927	0.226
9	.826	.155	.528	.594	.969	.098	.544	.803	0.196
10	1.042	-.245	.972	.454	.388	-.019	.393	.756	0.174
11	1.077	-.438	1.120	-.568	.246	.410	.297	.502	0.281
12	1.012	-.386	1.200	-.535	.661	1.760	.303	.819	0.434
13	.389	-.332	1.295	-.610	.327	1.212	-.582	.874	0.993
14	.502	-.035	.576	-.691	.712	2.312	.217	1.191	0.533
15	.167	.003	1.263	-.620	.310	1.590	.179	1.133	0.842
16	.298	.018	.816	-1.170	.198	1.495	-.609	.482	1.166
17	.069	.064	.845	-1.078	-.226	2.190	.511	1.737	1.253
18	-1.104	.164	.797	-.327	.983	2.583	.235	.539	0.606
19	-.200	-.126	-.615	-1.783	-1.165	.366	-.506	.061	0.272

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

AGE	Mortality		
	1971-89	1971-79	1980-89
1	-1.708	-1.431	-1.957
2	-1.281	-1.430	-1.146
3	-0.928	-1.058	-0.811
4	-0.325	-0.372	-0.282
5	0.046	0.039	0.052
6	0.245	0.208	0.279
7	0.358	0.364	0.353
8	0.433	0.317	0.538
9	0.427	0.273	0.566
10	0.437	0.375	0.493
11	0.437	0.451	0.425
12	0.433	0.258	0.592
13	0.386	0.274	0.487
14	0.570	0.446	0.682
15	0.469	0.344	0.582
16	0.531	0.651	0.423
17	0.513	0.303	0.702
18	0.413	0.377	0.446
19	-0.488	-0.643	-0.348

Table 21. COEFFICIENTS OF VARIATION (/100) FROM RV SURVEY.

AGE	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
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	0.297
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	0.1740	0.3058	0.231
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
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
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
8	0.1020	0.1388	0.2754	0.0957	0.1447	0.1607	0.1872	0.1025	0.1611	0.2032	0.2644	0.192	0.1672	0.0945	0.141
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
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
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
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
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
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
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
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
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
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
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
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
21	0.2945	.	.	0.5476	0.7075	.	1.0000	0.3592	0	0.6011	0	0	.	0.2937	0.166
22	1.0000	.	0.5856	0.4663	1.0000	0.4514	0.4541	0.8505	0	0	0	.	.	0.2208	0.223
23	.	0.6446	.	.	.	.	0.6346	.	0	0	0.6812	.	.	0.2208	0.376
24	1.0000	.	.	0.1500	.	0.7086	.	0.5335	0	0	0	.	.	0.2464	-
25	.	.	.	.	.	.	1.0000	.	.	.	0	.	.	0.7221	0.393
26	.	.	.	.	.	.	0.5210	0.0200	.	.	0	0	.	0.3294	-

Table 22. RV mean numbers per tow for ages 1+ to 20+ from 1971 to 1989 .

A G E	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	686.36	547.73
2+	271.56	229.36	237.47	563.22	530.99	942.59	1045.24	578.20	686.28	545.09
3+	263.15	221.20	230.33	546.66	526.41	937.36	1039.61	578.90	684.91	537.96
4+	237.08	206.54	206.98	489.07	503.82	884.87	959.50	566.64	678.10	502.79
5+	193.56	172.91	174.42	372.75	418.46	709.68	730.75	483.31	612.03	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	194.68	178.32	249.92	235.39	250.33	466.81	218.99
8+	63.10	61.59	62.58	142.28	115.55	153.01	113.41	137.23	262.86	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	33.88	56.28	47.34	72.53	37.66	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	8.04	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+	4.89	1.59	6.68	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	0.08	1.68	0.35	0.92	0.66	0.12	0.28	1.01	0.18

A G E	YEAR									
	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
1+	633.32	295.48	379.17	229.80	277.17	241.70	214.67	262.82	200.99	349.91
2+	630.56	293.79	376.23	229.58	275.81	237.94	214.18	262.03	200.24	349.03
3+	615.91	279.98	364.27	226.80	269.15	234.22	208.64	257.87	195.90	334.13
4+	586.01	265.49	334.81	221.67	251.76	220.98	195.76	241.48	183.75	299.19
5+	513.21	247.31	299.44	197.72	229.65	188.97	171.45	213.19	156.77	242.51
6+	415.40	212.58	256.07	165.43	187.90	160.45	135.06	178.65	119.37	163.82
7+	299.67	182.55	213.92	134.95	150.50	117.17	103.36	124.79	91.05	104.20
8+	174.25	137.60	182.56	107.41	123.49	90.35	70.89	90.61	59.88	73.37
9+	101.47	75.88	132.21	81.57	103.12	74.80	51.48	58.11	39.35	44.29
10+	52.38	43.59	84.42	57.80	85.58	64.28	34.85	38.39	26.49	27.92
11+	26.70	22.09	56.77	29.62	72.46	57.62	24.50	26.74	17.66	17.35
12+	15.03	13.03	29.29	19.16	54.57	48.72	16.68	21.75	13.13	9.93
13+	9.38	9.05	15.25	10.19	36.10	34.74	9.38	15.94	8.90	6.51
14+	6.13	7.00	9.40	5.96	20.79	25.20	6.86	10.55	5.77	3.77
15+	4.09	4.79	6.54	4.36	13.01	14.16	3.89	6.04	3.52	2.61
16+	2.62	3.55	4.26	2.75	9.82	10.34	2.67	3.65	2.15	1.29
17+	1.33	2.30	3.03	2.10	6.83	6.00	1.99	2.63	1.38	0.70
18+	0.91	1.34	1.81	1.55	4.75	5.55	1.39	1.38	0.75	0.46
19+	0.74	0.95	0.91	1.02	3.15	2.94	0.96	1.02	0.53	0.28
20+	0.36	0.44	0.56	0.61	2.42	2.34	0.55	0.66	0.32	0.16

Table 23. TOTAL 2 AMER PLAICE (4T) FROM RV

GROUP	YEAR									
	1971	1972	1973	1974	1975	1976	1977	1978	1979	
1+	0.17345	-0.0302	-0.85993	0.06038	-0.57298	-0.10337	0.592761	-0.42711	0.48617	
2+	0.20512	-0.0042	-0.83379	0.06759	-0.56832	-0.09797	0.594333	-0.42557	0.49925	
3+	0.24223	0.0664	-0.75299	0.08201	-0.51936	-0.02334	0.606877	-0.42009	0.56531	
4+	0.31563	0.1690	-0.58829	0.15592	-0.34299	0.19137	0.685754	-0.35981	0.73119	
5+	0.32230	0.2355	-0.45487	0.36231	-0.07845	0.52835	0.672171	-0.26612	0.89428	
6+	0.38114	0.2679	-0.35511	0.43275	0.03748	0.65379	0.513682	-0.22402	1.05776	
7+	0.56283	0.2269	-0.28245	0.52268	0.15308	0.79013	0.539585	-0.12146	1.20901	
8+	0.65796	0.1086	-0.20777	0.82996	0.04398	0.94187	0.599851	-0.04906	1.32250	
9+	0.60208	-0.0355	-0.01847	0.78418	0.04383	1.07184	0.461294	-0.25548	1.22806	
10+	0.79898	-0.2202	0.17023	0.69173	0.02828	1.13942	0.556583	-0.23340	1.17620	
11+	0.87660	-0.4923	0.40896	0.75080	0.00142	1.15217	0.556068	-0.29686	1.20489	
12+	1.08766	-0.6413	0.46391	0.58722	-0.19118	1.18427	0.475244	-0.37211	1.24594	
13+	1.27021	-0.9825	0.58547	0.58318	-0.01300	1.19705	0.678181	-0.38309	1.50201	
14+	1.48929	-1.1458	0.83112	0.57889	0.18282	1.19932	0.551535	-0.56516	1.81928	
15+	1.46847	-1.4443	1.09631	0.33760	0.19213	1.25365	0.671945	-0.51434	1.81678	
16+	1.99655	-1.5832	1.40124	0.05675	0.34809	1.14854	0.604088	-0.60168	1.79387	
17+	1.97606	-2.1871	1.60186	-0.44484	0.78481	1.15206	0.834461	-0.86020	1.80332	
18+	2.06897	-2.4759	2.02002	-0.34720	1.30833	0.55165	0.704982	-0.90912	1.87180	
19+	2.07844	-2.6391	2.25279	-0.57054	0.82098	1.76359	0.944462	-0.87745	2.04410	

GROUP	Year									
	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
1+	-0.14083	0.768111	-0.24160	0.50173	-0.18250	0.152612	0.12088	-0.19936	0.27195	-0.553
2+	-0.12215	0.811890	-0.21503	0.50613	-0.15902	0.163451	0.13141	-0.18564	0.29085	-0.514
3+	-0.08555	0.841524	-0.17885	0.49671	-0.10441	0.197197	0.17937	-0.14618	0.33888	-0.425
4+	-0.02051	0.862694	-0.12034	0.52671	-0.03537	0.286888	0.25378	-0.08529	0.43201	-0.279
5+	0.01733	0.881367	-0.03481	0.59337	0.05094	0.358574	0.33587	-0.04114	0.57996	-0.046
6+	0.10257	0.822218	-0.00628	0.64055	0.09459	0.472284	0.43976	0.07909	0.67402	0.133
7+	0.22854	0.778331	-0.00005	0.68895	0.08874	0.510272	0.50250	0.13165	0.73429	0.212
8+	0.31715	0.831338	0.03996	0.80562	0.04076	0.501342	0.56250	0.19879	0.83407	0.296
9+	0.36322	0.844935	-0.10665	0.82740	-0.04799	0.472645	0.76376	0.29340	0.78557	0.335
10+	0.45799	0.863400	-0.26418	1.04735	-0.22605	0.395582	0.96458	0.19276	0.77649	0.411
11+	0.50039	0.717409	-0.28212	1.08618	-0.61103	0.396945	1.23966	0.11906	0.78339	0.557
12+	0.41748	0.507283	-0.15733	1.05584	-0.63347	0.451593	1.64751	0.04538	0.89356	0.677
13+	0.31504	0.292670	-0.03794	0.93951	-0.71307	0.359449	1.62218	-0.11755	1.01616	0.822
14+	0.05007	0.246664	0.06797	0.76824	-0.78065	0.384051	1.86843	0.12730	1.09766	0.736
15+	-0.19771	0.141597	0.11726	0.86634	-0.81195	0.229698	1.66834	0.06368	1.03294	0.909
16+	-0.06204	0.130265	0.15838	0.70733	-0.90972	0.204980	1.64789	0.01509	0.97264	0.961
17+	-0.14141	-0.007491	0.23958	0.67031	-0.81621	0.207527	1.75014	0.36605	1.25467	0.835
18+	-0.54286	-0.043017	0.38698	0.57352	-0.70915	0.479735	1.75462	0.30950	0.95696	0.429
19+	-0.17185	0.519875	0.49343	0.39999	-0.86396	0.297252	1.67625	0.34484	1.15924	0.272

Table 24. Biomass (t): age 1 to 9 and fishable biomass (age 10+) for 1987-1990.

YEAR	Age 1 to 9			Age 10+		
	MALES	FEMALES	TOTAL	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
1990	32,323.1	30,996.9	63,320.0	5,405.0	12,381.0	17,786.0

Table 25. 4T unsexed American plaice mean catch per tow by strata for ages 1 to 10 from 1990 RV survey. Strata numbers correspond to Figure 5.

STRATA	AGE				
	1	2	3	4	5
415	0.0	0.0	0.0	0.0	0.0
416	0.8	6.3	4.0	0.6	0.0
417	0.0	0.0	0.0	0.0	0.0
418	0.1	1.5	3.2	0.6	0.1
419	0.3	6.4	12.2	2.3	0.2
420	0.0	0.4	0.5	0.1	0.0
421	0.9	6.4	6.5	1.2	0.2
422	0.1	11.0	18.8	3.4	0.3
423	2.0	20.8	19.8	3.5	0.2
424	1.6	14.1	18.4	3.3	0.3
425	0.0	0.0	0.0	0.0	0.0
426	0.0	0.4	0.6	0.1	0.0
427	0.0	0.0	0.0	0.0	0.0
428	-	-	-	-	-
429	0.4	8.2	9.5	1.6	0.1
430	-	-	-	-	-
431	0.2	3.5	4.4	0.8	0.1
432	0.0	0.0	0.0	0.0	0.0
433	3.7	53.3	61.2	10.1	0.6
434	0.3	11.9	16.3	2.8	0.2
435	0.0	0.0	0.0	0.0	0.0
436	0.0	0.2	0.4	0.1	0.0
437	2.2	41.1	38.3	5.5	0.2
438	0.0	0.5	0.6	0.1	0.0
439	0.0	0.0	0.0	0.0	0.0

Table 26. 4T females American plaice mean catch per tow by strata for ages 1 to 10 from 1990 RV survey. Strata numbers correspond to Fig. 5.

STRATA	AGE									
	1	2	3	4	5	6	7	8	9	10
415	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.0
416	0.0	1.5	6.1	10.6	13.0	10.0	5.2	4.8	2.2	1.7
417	0.0	1.8	12.2	33.6	71.5	69.0	33.8	28.2	11.8	7.6
418	0.0	2.6	22.6	117.1	212.7	150.9	58.4	42.7	18.0	12.9
419	0.0	5.4	45.8	151.1	204.1	138.7	53.8	44.1	17.8	14.9
420	0.0	0.0	0.1	0.3	0.9	1.5	1.4	2.2	1.3	2.0
421	0.0	0.9	7.6	13.2	9.0	5.0	2.4	2.3	0.9	0.6
422	0.0	115.4	153.2	144.9	148.1	137.7	118.7	100.4	98.4	8.8
423	0.0	2.8	14.8	31.1	39.3	39.8	26.3	26.5	12.5	9.5
424	0.0	3.1	22.1	66.1	80.7	59.1	28.9	25.6	11.0	6.7
425	0.0	0.0	0.0	0.2	0.3	0.1	0.1	0.1	0.0	0.0
426	0.0	0.1	0.5	1.7	2.2	3.0	2.2	2.7	1.5	1.6
427	0.0	0.8	3.9	5.3	5.3	3.8	2.4	2.8	1.5	1.3
428	0.0	0.0	0.0	0.0	0.2	0.2	0.2	0.3	0.1	1.3
429	0.0	1.5	7.9	16.4	23.0	21.9	13.9	13.6	6.5	5.0
430	-	-	-	-	-	-	-	-	-	-
431	0.0	0.6	3.9	11.0	17.2	18.9	12.5	12.4	5.7	4.1
432	3.9	2.2	8.9	5.6	1.6	0.9	0.1	0.1	0.0	0.0
433	0.0	1.4	11.6	30.7	38.5	30.3	14.1	12.1	5.4	4.0
434	0.0	1.1	8.8	20.8	26.9	23.0	12.3	11.9	5.7	4.7
435	0.0	3.6	3.5	0.4	0.3	0.6	0.4	0.7	0.5	0.5
436	0.0	0.3	1.5	2.9	5.7	5.8	4.1	4.2	2.1	1.7
437	0.0	0.9	7.6	21.8	28.4	24.1	10.8	8.1	3.3	2.3
438	0.0	0.5	3.8	5.7	6.1	6.9	4.7	5.4	2.7	2.5
439	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

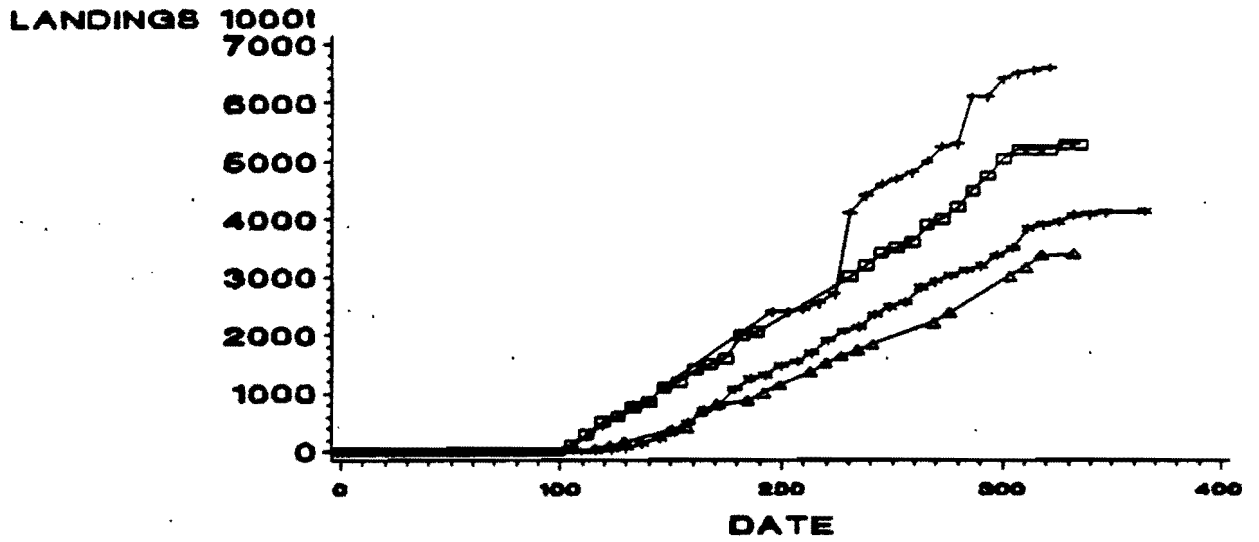
Table 27. 4T males American plaice mean catch per tow by strata for ages 1 to 10 from 1990 RV survey. Strata numbers correspond to Fig. 5.

STRATA	AGE									
	1	2	3	4	5	6	7	8	9	10
415	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
416	0.0	0.1	5.1	10.0	11.8	7.7	3.9	3.8	2.6	1.4
417	0.0	2.2	19.9	54.9	115.5	92.1	52.1	55.0	36.9	22.3
418	0.0	0.3	7.8	54.7	129.7	96.5	48.7	46.9	29.3	16.0
419	0.1	4.1	74.3	211.7	235.5	119.2	48.0	36.6	27.2	13.4
420	0.0	0.2	0.6	0.3	0.3	0.3	0.2	0.4	0.2	0.2
421	0.0	0.1	1.6	2.7	1.5	0.9	0.5	0.4	0.2	0.1
422	0.0	0.9	11.6	46.1	100.8	76.6	40.6	38.4	24.6	13.9
423	0.0	5.3	26.7	45.4	65.5	49.0	26.6	27.4	18.0	10.5
424	0.0	6.0	54.5	110.6	134.7	80.2	35.1	25.4	16.0	7.9
425	0.0	0.0	0.2	0.5	0.4	0.1	0.0	0.0	0.0	0.0
426	0.0	0.0	0.1	0.4	1.1	1.1	0.7	0.8	0.6	0.4
427	0.0	1.1	6.1	6.7	6.7	4.2	2.7	2.9	2.4	1.7
428	0.0	0.3	0.3	0.2	0.3	0.1	0.1	0.0	0.1	0.1
429	0.1	1.0	4.8	13.6	20.9	17.4	10.8	12.8	8.9	5.6
430	-	-	-	-	-	-	-	-	-	-
431	0.2	2.7	3.4	7.0	14.7	15.0	10.8	13.5	9.6	6.4
432	0.0	0.1	1.8	3.1	0.8	0.1	0.0	0.0	0.0	0.0
433	0.0	0.4	7.3	16.8	19.9	13.7	8.1	8.7	6.5	4.2
434	0.0	3.5	9.6	13.8	17.6	12.9	7.9	9.3	6.8	4.1
435	0.1	3.6	0.4	0.0	0.4	0.4	0.4	0.4	0.4	0.3
436	0.1	2.6	2.2	4.8	6.8	4.7	3.0	3.4	2.5	1.6
437	0.0	0.2	2.7	8.2	10.8	7.4	3.8	4.0	2.6	1.5
438	0.0	2.2	5.7	10.7	7.0	3.0	2.0	2.1	2.0	1.4
439	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

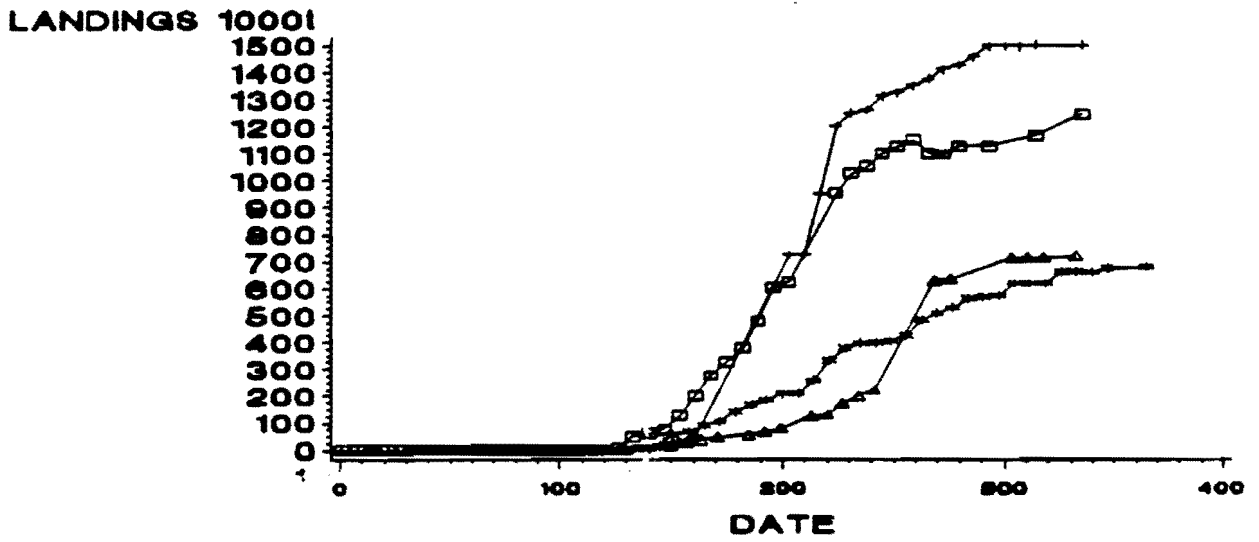
Table 28. 4T total American plaice mean catch per tow by strata for ages 1 to 10 from 1990 RV survey. Strata numbers correspond to Fig. 5.

STRATA	AGE									
	1	2	3	4	5	6	7	8	9	10
415	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.2	0.1	0.0
416	0.8	8.8	15.2	21.2	22.4	17.7	9.1	8.8	4.8	3.1
417	0.0	4.0	32.1	88.5	149.1	161.1	85.9	83.2	48.7	29.9
418	0.1	4.4	30.4	172.4	246.9	247.4	107.1	89.6	47.3	28.9
419	0.4	15.9	132.5	365.1	386.8	257.9	101.6	40.7	45.0	28.3
420	0.0	0.6	1.2	0.7	0.6	1.8	1.8	2.8	1.5	2.2
421	0.9	7.4	15.7	17.1	14.9	5.9	2.9	2.7	1.1	0.7
422	0.1	127.3	163.6	194.4	246.0	214.3	159.3	138.8	123.0	22.7
423	2.0	29.0	61.3	80.0	96.8	88.8	52.9	53.9	30.5	20.0
424	1.6	23.2	95.0	180.0	20.1	139.3	64.0	51.0	26.0	14.6
425	0.0	0.0	0.2	0.7	0.6	0.2	0.1	0.1	0.0	0.0
426	0.0	0.5	1.2	2.2	2.8	4.1	2.9	3.5	2.1	2.0
427	0.0	1.9	10.0	12.0	12.0	8.0	5.1	5.7	3.9	3.0
428	0.0	0.3	0.3	0.2	0.3	0.3	0.3	0.3	0.2	1.4
429	0.5	10.7	22.2	31.6	37.4	39.3	24.7	26.4	15.4	10.6
430	-	-	-	-	-	-	-	-	-	-
431	0.4	6.8	11.7	18.8	25.8	33.9	23.3	25.9	15.3	10.5
432	3.9	2.3	10.7	6.7	6.4	1.0	0.1	0.1	0.0	0.0
433	3.7	55.1	80.1	57.6	51.2	44.0	22.2	20.8	11.9	8.2
434	0.3	16.5	34.7	37.4	38.6	35.9	20.2	21.2	12.5	8.8
435	0.1	7.2	3.9	0.4	0.8	1.0	0.8	1.1	0.9	0.8
436	0.1	3.1	4.1	7.8	9.7	10.5	7.1	7.6	4.6	3.3
437	2.2	42.2	48.6	35.5	32.8	31.5	14.6	12.1	5.9	3.8
438	0.0	3.2	10.1	16.5	12.7	9.9	6.7	7.5	4.7	3.9
439	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

# MOBILE GEAR



# FIXED GEAR



# TOTAL CATCH

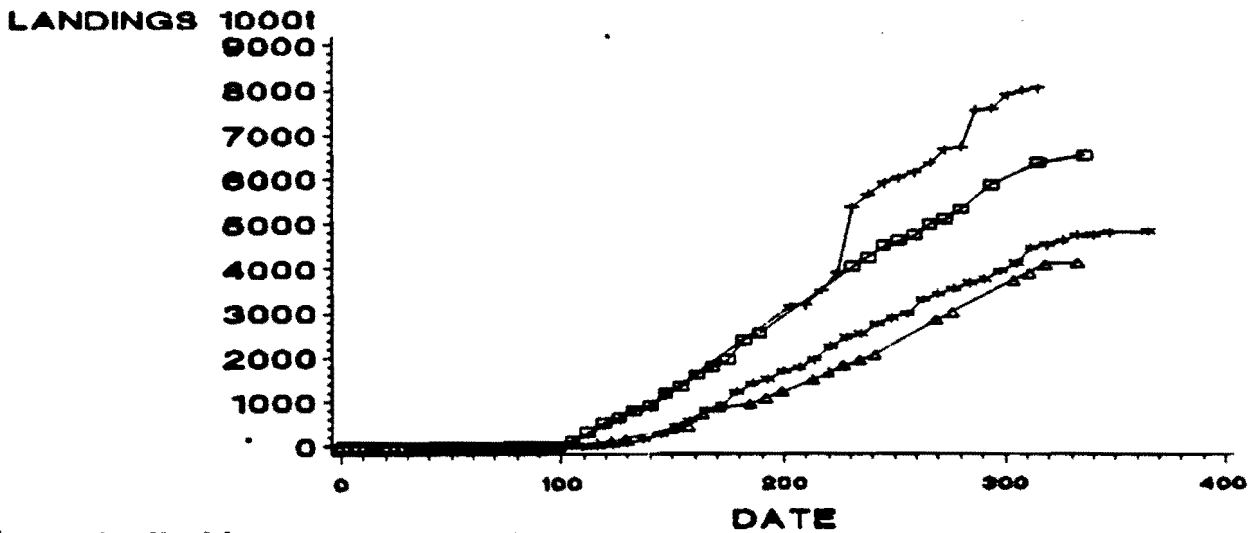


Figure 1. Weekly catch of American plaice.



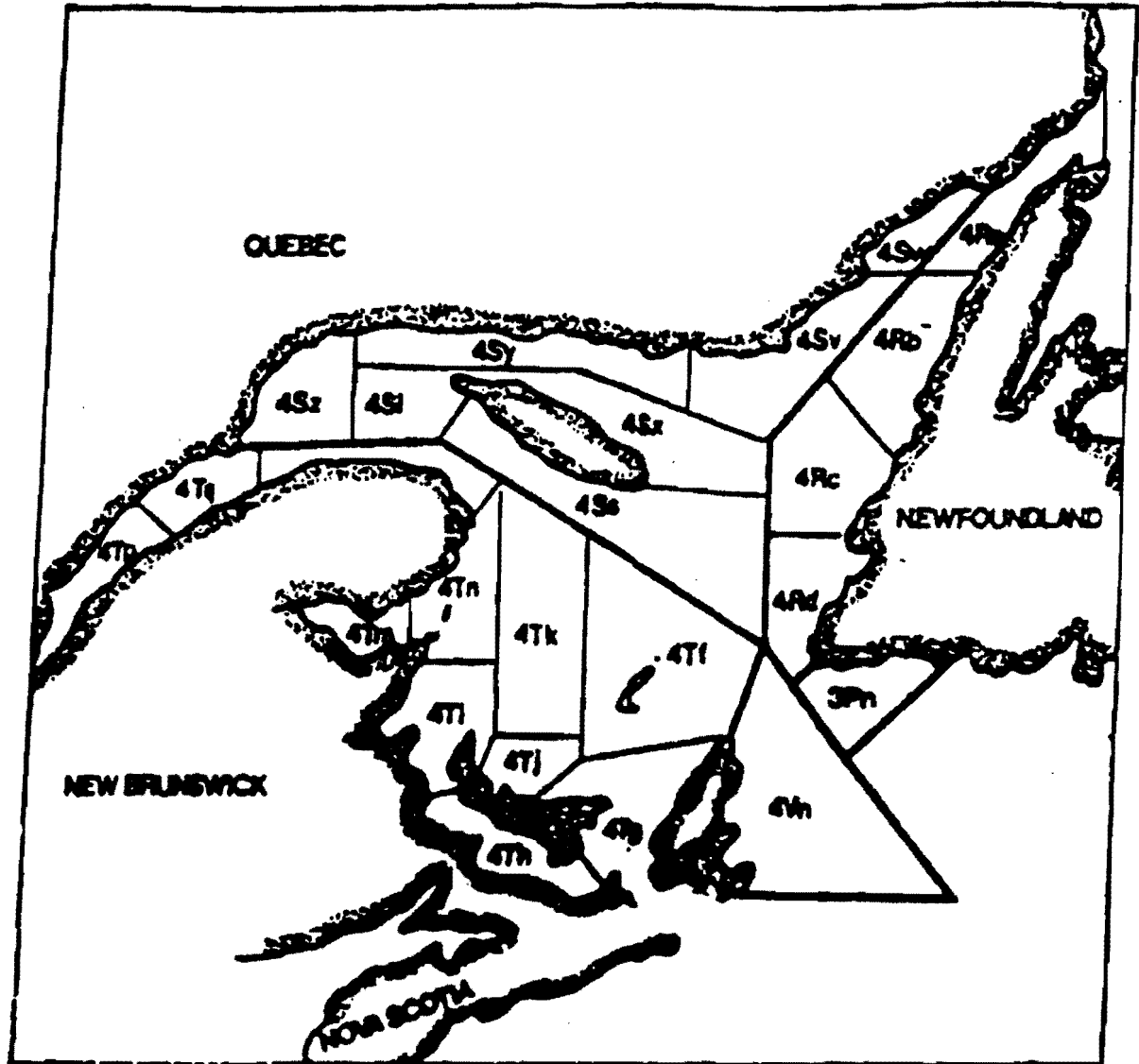


Figure 2. Gulf of St. Lawrence showing unit areas.

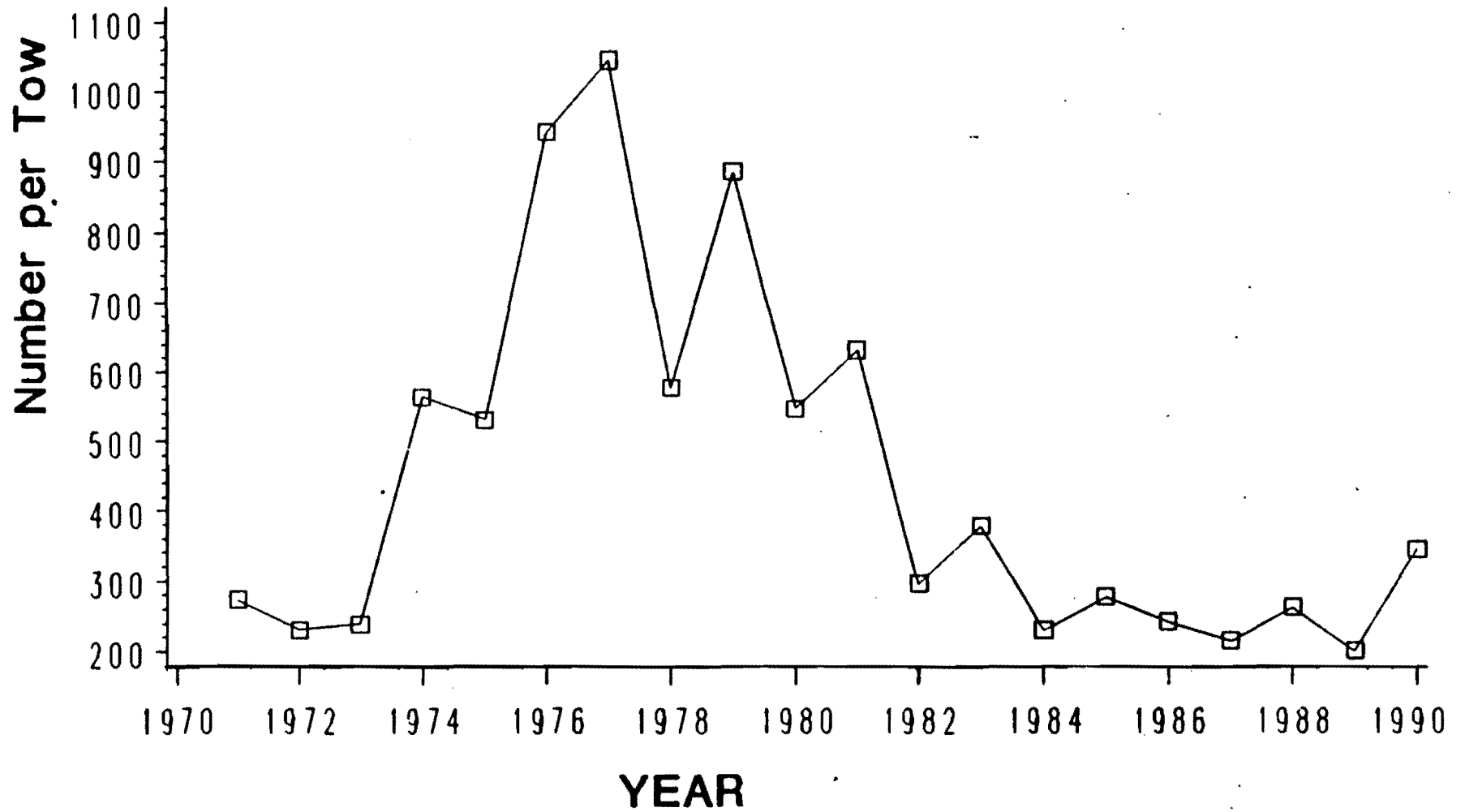


Figure 3. Mean number per tow from research vessel survey.

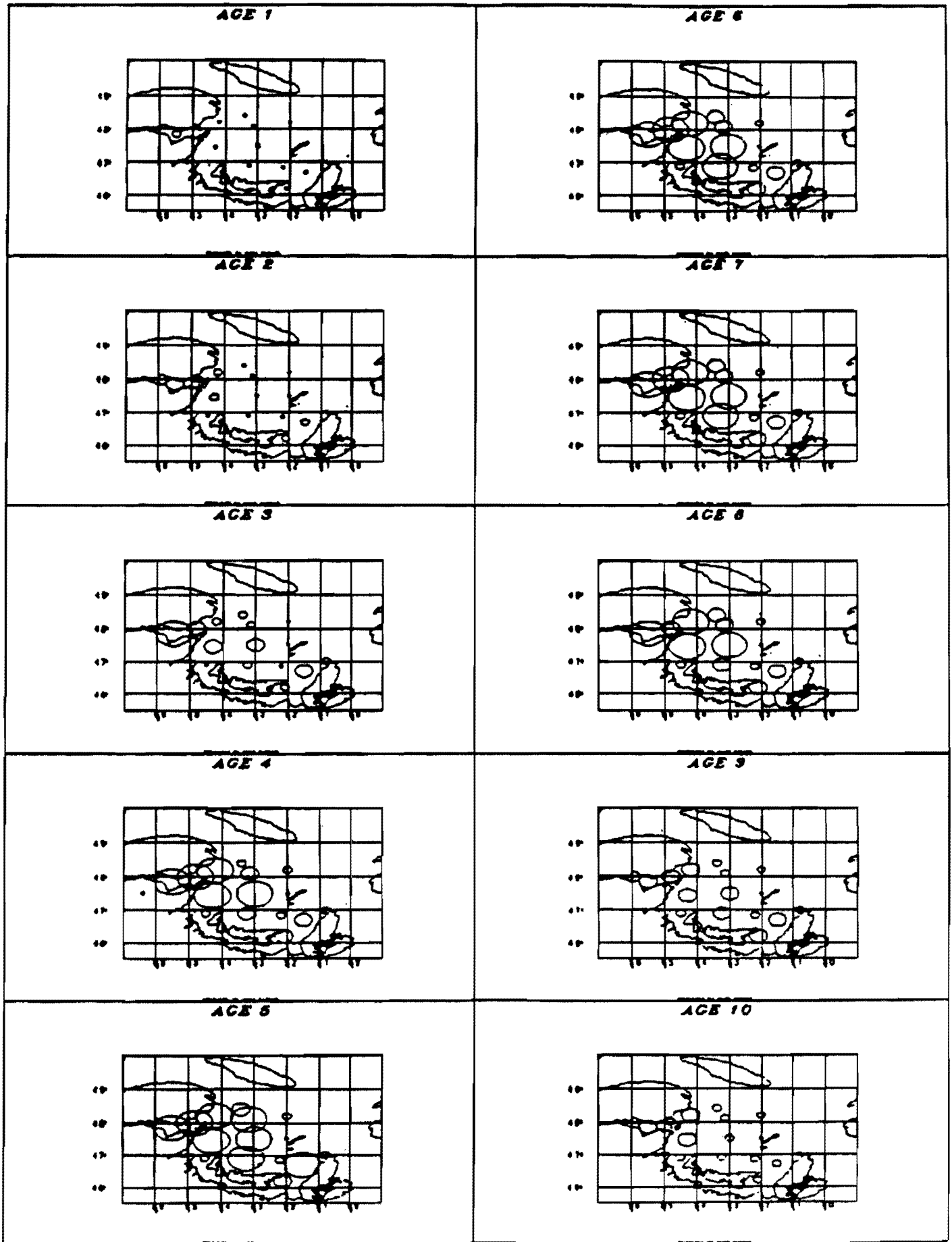


Figure 4. R.V. distribution of American plaice, from 1971 to 1989  
(Circle size corresponds to fish density)

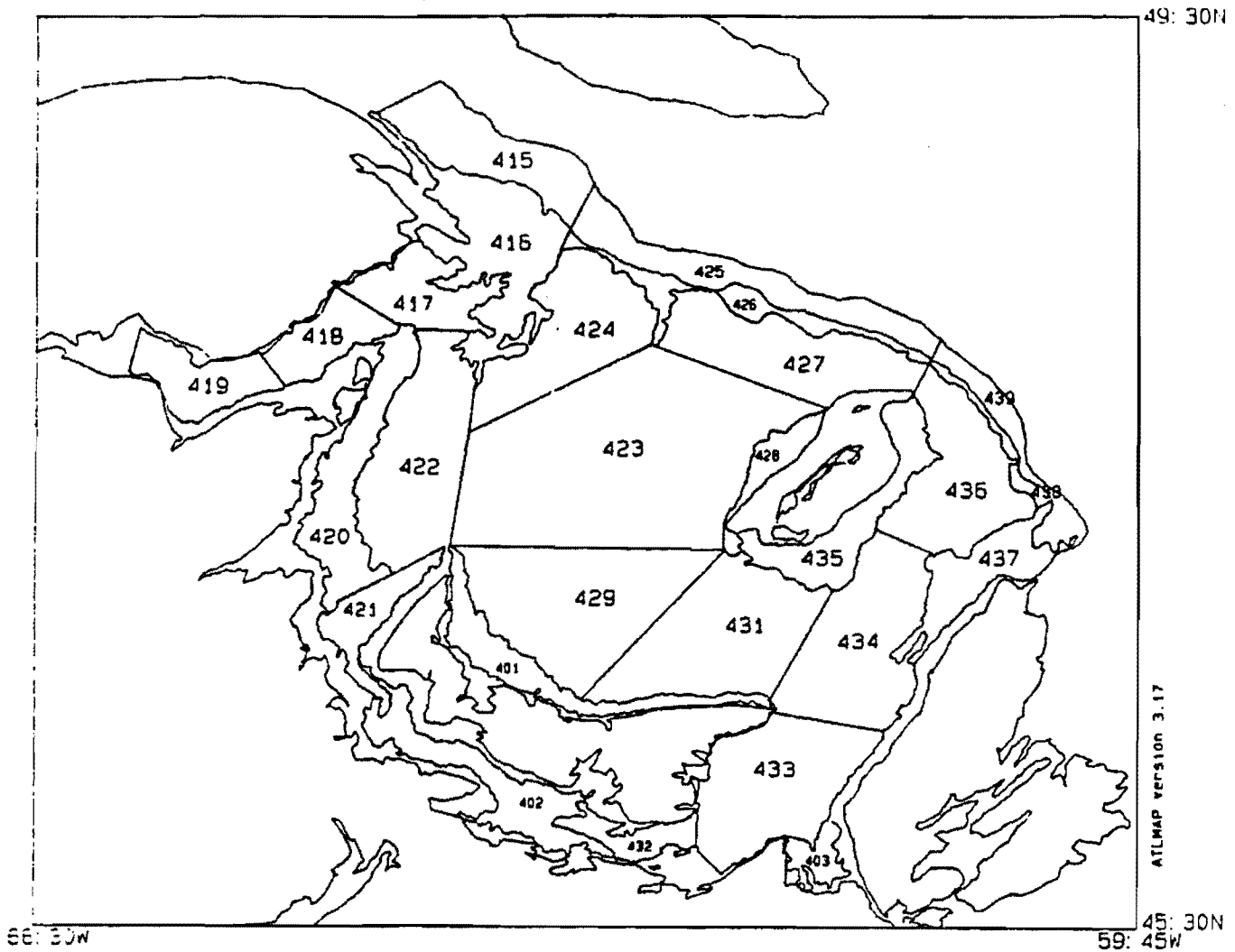


Figure 5. The southern Gulf of St. Lawrence showing the stratification scheme used for groundfish surveys of the Gulf Region, Canadian Department of Fisheries and Oceans. Stratification was based on depth contours.

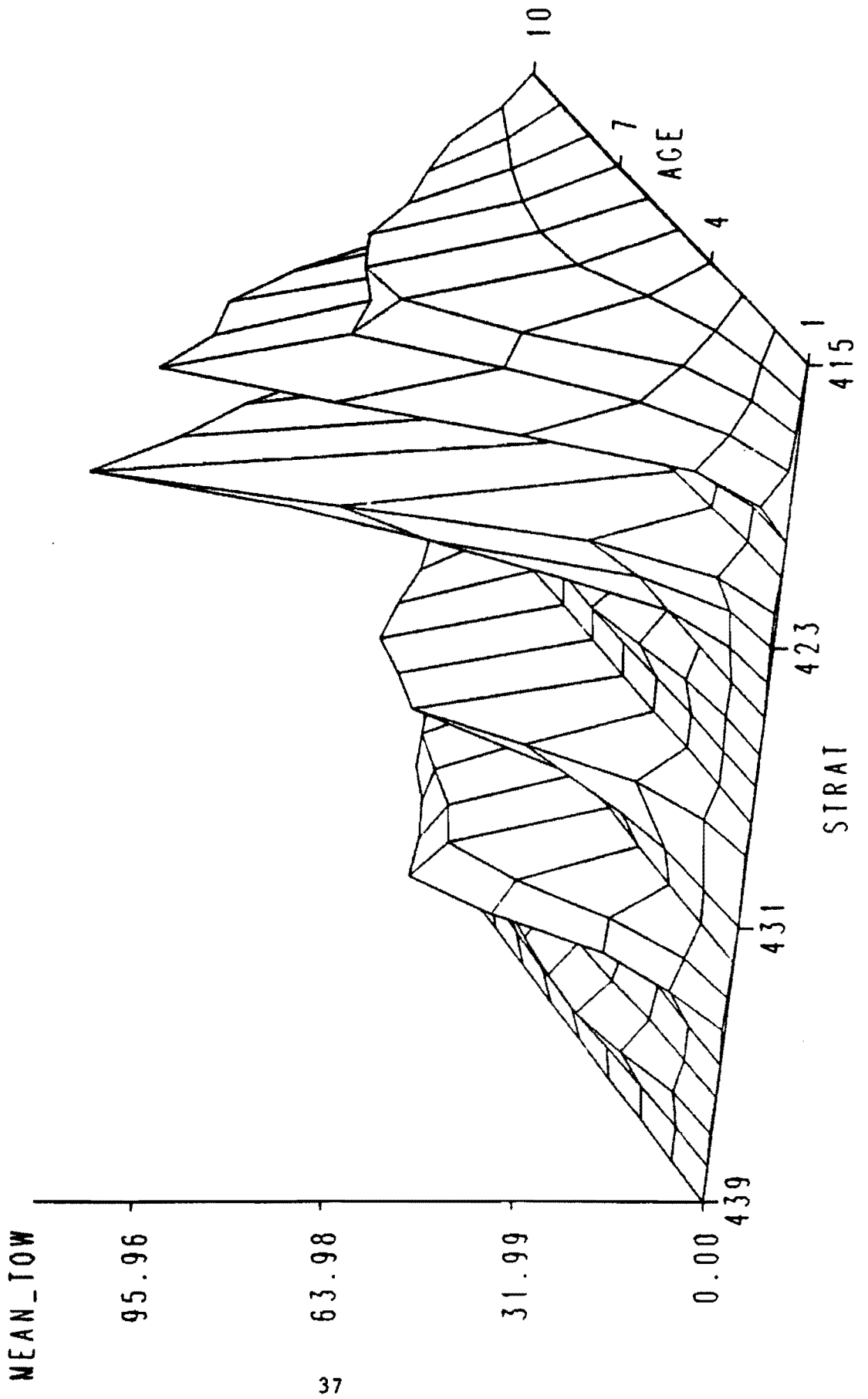


Figure 6. Mean number/tow at age by stratum, 1971-1989

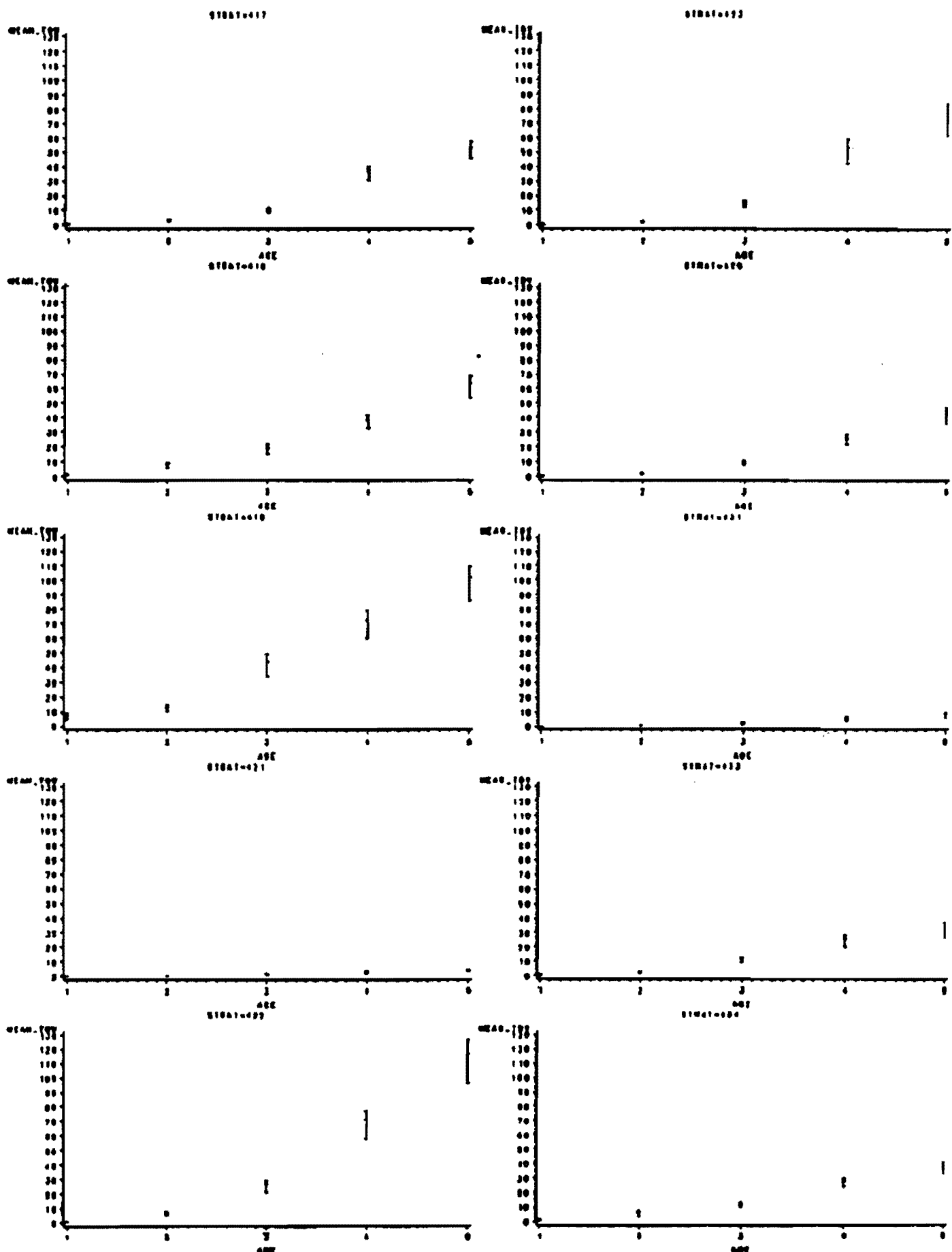


Figure 7. Mean number per tow of ages 1 to 5 for selected strata.

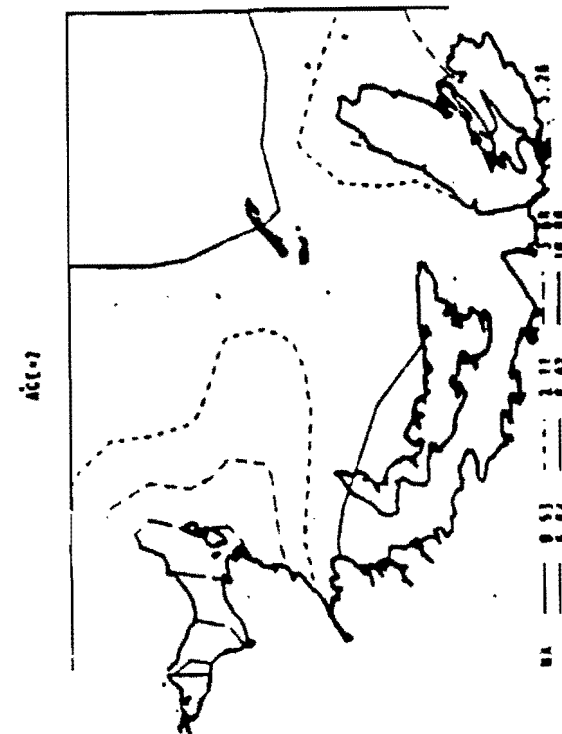
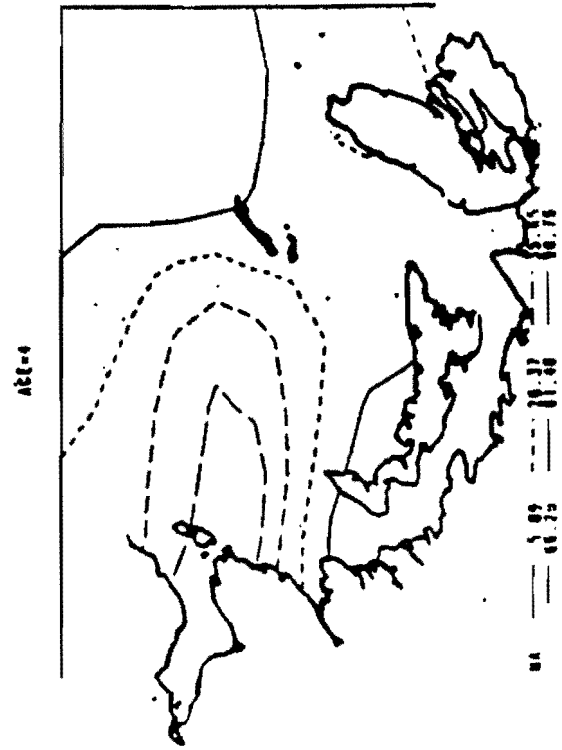
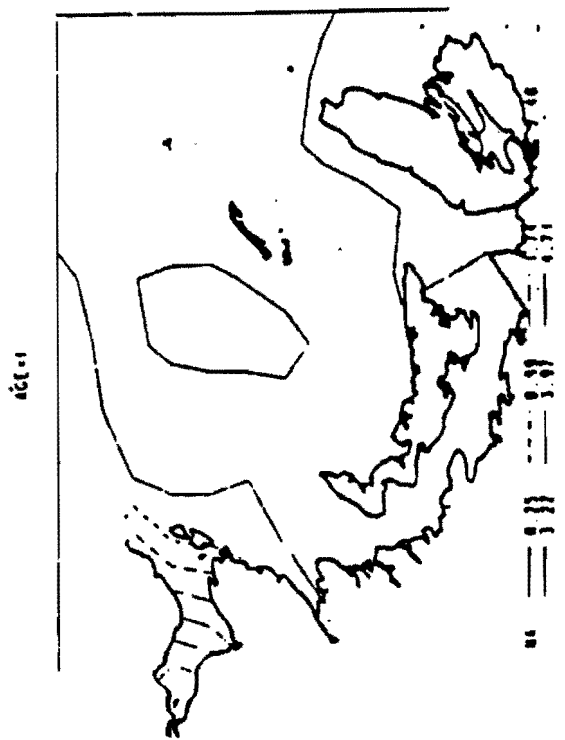
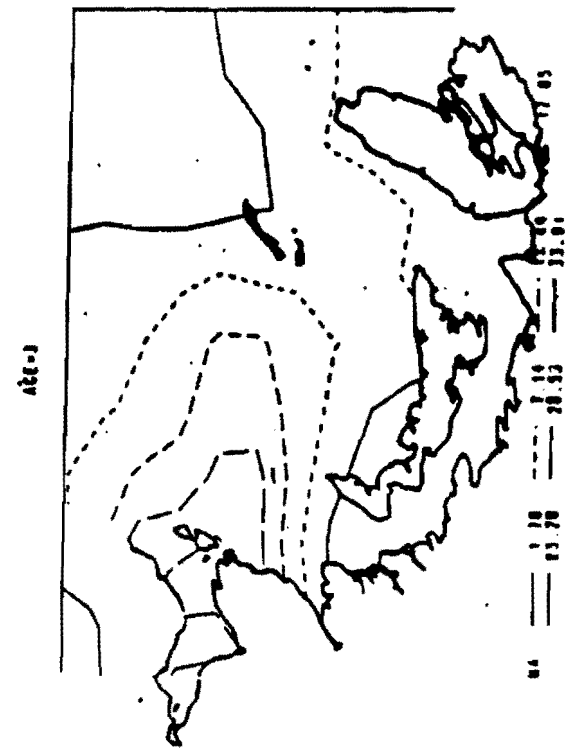
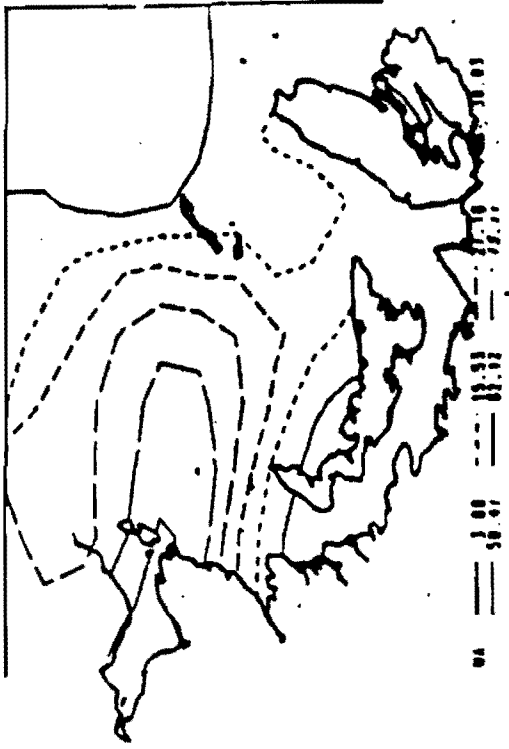
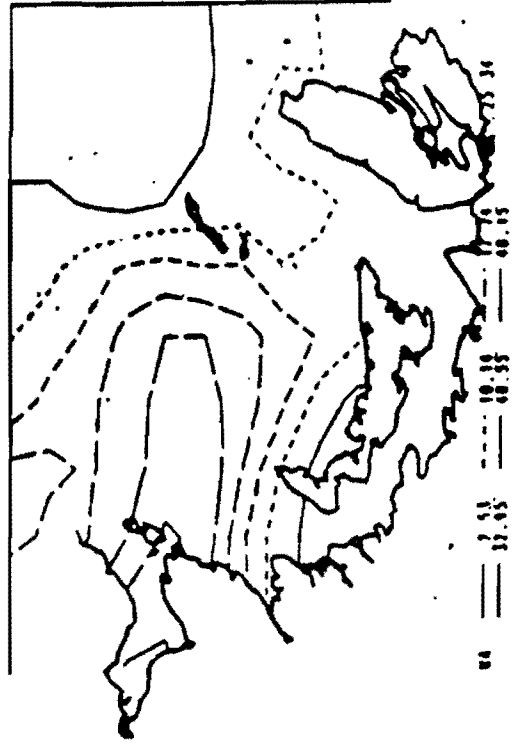


Figure 8. Expected densities of ages 1 to 10 in the southern Gulf St. Lawrence (1971 to 1989).

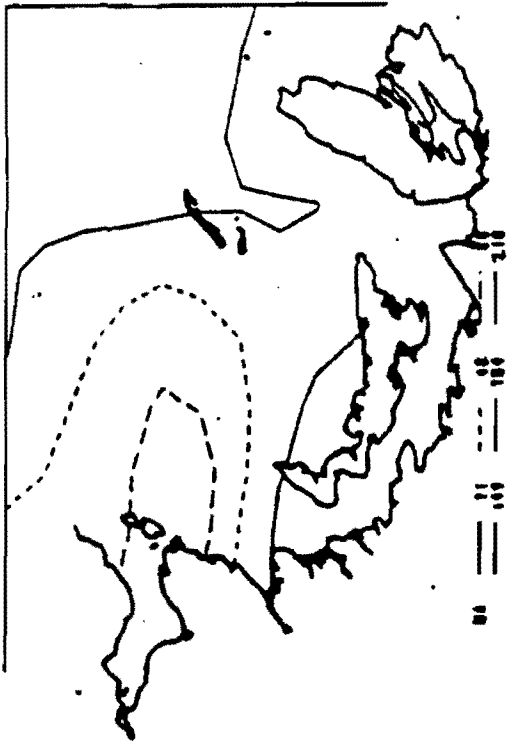
alt-07



alt-08



alt-05



alt-06

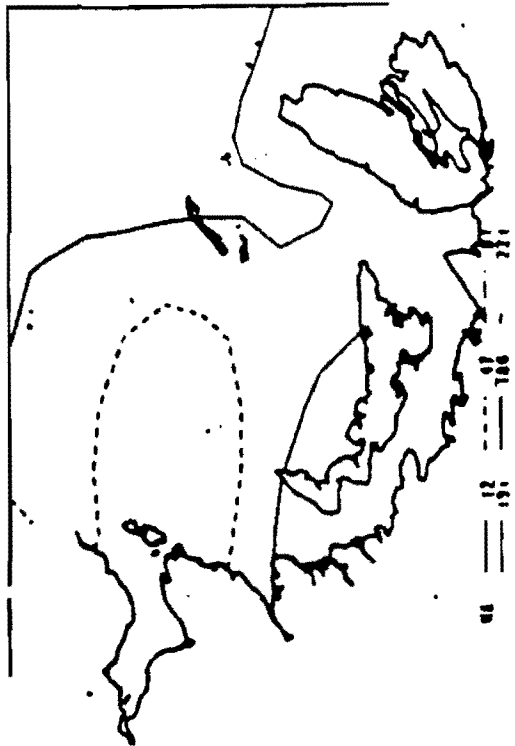


Figure 8. Continued



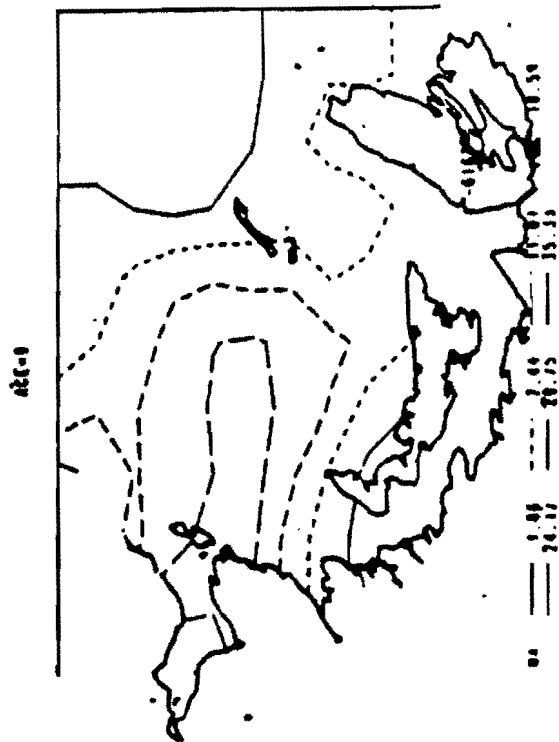
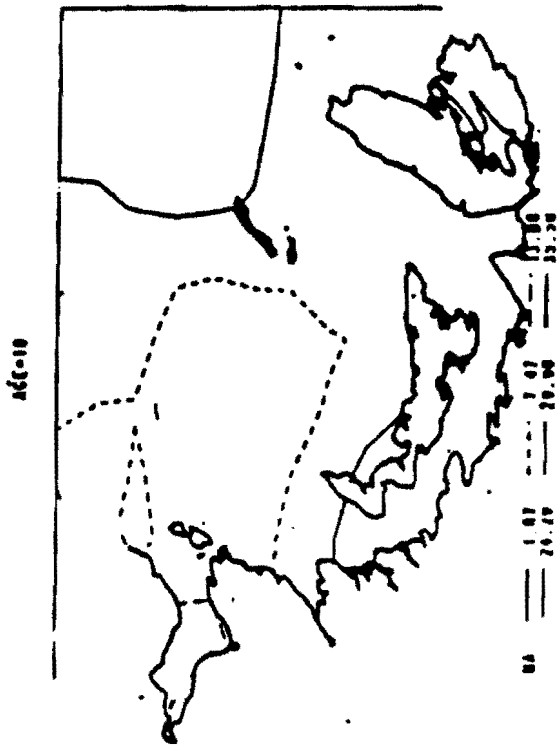


Figure 8. Continued

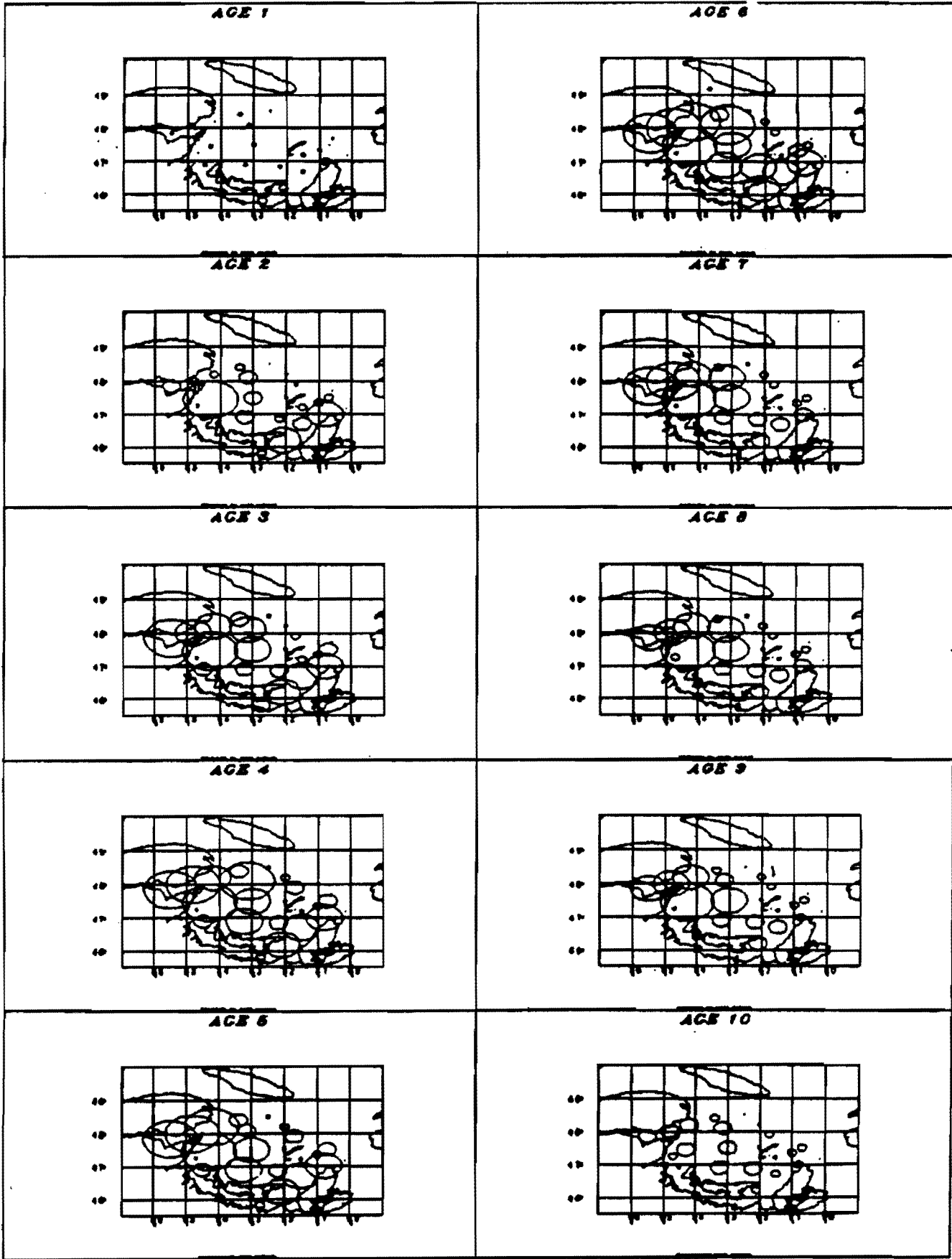


Figure 9. Distribution of average catches from September RV survey of age 1 to 10 plaice in the southern Gulf of St. Lawrence, 1990. (Circle size corresponds to fish density)