Northwest Atlantic Fisheries Organization

Serial No. N4099 **NAFO SCR Doc. 99/40**

SCIENTIFIC COUNCIL MEETING – JUNE 1999

An Assessment of American plaice in NAFO Divisions 3LNO

by

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Abstract

Catches from this stock were generally in the range of 40,000 to 50,000 t per year throughout the 1970's and 1980's, before declining to low levels in the early 1990's. There has been no directed fishing on this stock since 1993. The TAC's in 1995-99 have been set at 0. The catch in 1998 was 1618 t, an increase of more than 200 t from 1997. Catches in 1998 were mainly in the NAFO Regulatory Area (NRA) and as bycatch in the Canadian yellowtail flounder fishery. The Canadian spring surveys show a large decline in abundance and biomass from the mid to late 1980's until 1998 with current biomass being only 14% of that of the mid 1980's. The fall survey has also shown large declines and the biomass is only 30% of that of 1990. Mortality remains high on the youngest ages but has decreased on the older ages. The strength of the 1994 cohort appears to be above the average of those of the 1980 to 1996 period but below the level of those of the 1970's. A VPA was conducted which indicates that biomass and SSB are at very low levels. Since the moratorium F has been below the levels of the 1970's and 1980's but has increased since 1995. Most indicators suggest that this stock remains at a low level.

TAC regulation

This stock has been under TAC regulation since 1973 when a TAC of 60,000 t was established. From 1973-87, the TAC varied from 47,000 t to 60,000 t (Table 1) but was lowered to 33,585 t in 1988. Further reductions followed, bringing the TAC to 10,500 t in 1993. In 1994, a TAC of 4,800 t was implemented, but the Fisheries Commission of NAFO stated that no directed fisheries were to take place on this stock. The TAC has been set at 0 since then.

Catch trends

Catches increased from about 20,000 t in the early 1960s to a peak of 94,000 t in 1967, were relatively stable around 45,000-50,000 t in 1973-82, then declined to 39,000 t in 1984-85 (Table 1, Fig. 1). Catches increased to 65,000 t in 1986 and then declined rapidly thereafter, to about 7,400 t in 1994. The catch declined following the moratorium in 1995, but has steadily increased from 637 t in 1995, to 913 t in 1996, 1407 t in 1997 and 1618 t in 1998. Most of these catches occurred as by catch in the G. halibut and skate fisheries in the NRA. In 1998, the Canadian catch totalled about 212 t, much of which was likely taken as by catch in the yellowtail flounder fishery (Table 2).

From 1977 to 1982, the catch was taken almost exclusively by Canadian vessels, but the catch by other nations increased rapidly from less than 2,000 t in 1981-82 to over 30,000 t in 1986 as new fisheries were developed in the Regulatory Area. Catches from these fleets have generally declined in recent years, as has the Canadian catch (Tables 1 and 2), although non-contracting party (NCP) catches in 1993 were an exception to this trend. Considerable doubts have arisen about some nominal catches in the 1985 to 1994 period, resulting in various catch estimates being used. These

include surveillance estimates, breakdowns of unspecified flounder catches by S. Korea prior to 1991 based on reported flounder catches, and any other estimates deemed by Scientific Council to be reliable. There is also some uncertainty regarding catches prior to 1973, when large amounts of unspecified flounder catches from some nations were broken down by species based on estimates of species composition. As well, estimates of discards are not available, and are believed to be substantial during some periods.

There was some sampling from the Spanish and Portuguese by catch from the trawler fleets in 1998. For the Spanish trawlers the mode in Div. 3L was 30-37 cm while in Divs. 3NO it was 36-40 cm (Junquera et al. 1999). For the Portuguese trawler fleet the mode in Div. 3L was 34-36 cm, in Div. 3N 36-38 cm and in Div. 3O there was a clear peak at 40 cm (Alpoim et al., 1999). There was no sampling of the Canadian by catch.

Canadian research vessel surveys

Spring

Stratified-random surveys have been carried out on the Grand Bank on Canadian research vessels in the spring (April to June period) of each year from 1971 to 1998, with the exception of 1983. The stratification scheme used is shown in Figure 2. The data can be split into 3 time periods, based on the trawl used in each period: 1971-82 was Yankee 36, 1983-95 was Engel 145, and 1996-98 was Campelen 1800 (see McCallum and Walsh (1996) for a description of the various trawls). Conversions exist for the first to second series (Gavaris and Brodie 1984), and from the second to the third (Morgan et al. 1998). However, data from the first series have not been converted to be comparable with the third series. Thus comparable data exist for 1971-95, and for 1984 to 1998. A full comparison between the Engel and Campelen data series is given in Brodie et al. (1998).

Biomass estimates for each Division by stratum and depth for 1996 to 1998 are given in Tables 3-5. Biomass and confidence intervals for the 1998 survey for each Division are given in Table 6. In the spring survey in 1998 the biomass estimates for 3L, 3N and 3O were 19 000, 25 000 and 58 000 t respectively. The values for 3L and 3O were up slightly from the 1997 estimates of 13 000 and 51 000 t, while the value for 3N was down slightly from the 1997 estimate of 27 000 t. In 1998 four strata in the inshore area of Div. 3L (784, 785, 786, and 787) were surveyed for the first time during the spring survey. These strata accounted for a total of 1200 t. Biomass in Div. 3LNO combined has been relatively stable since 1996 but is only 14% of that of the mid 1980's (Fig. 3).

Tables 7-10 and Fig. 4 and 5 show the abundance by Division and for Div. 3LNO combined from 1985 to 1998. Abundance and confidence intervals for the 1998 survey are given in Table 6. The total abundance for 1998 was slightly higher than that in 1997. Div. 3L and 3O have shown an increase of 30% and 10% respectively in 1998 over 1997 while abundance in Div. 3N declined by 14%. The abundance of younger fish (ages 0 to 5) has declined since 1996, while the abundance of age 6+ fish has increased slightly (Table 10). In 1998, 18.5% of the population was made up of fish age 9+ while this was less than 8% in 1996 and 1997.

American plaice are distributed throughout the Div. 3LNO area but the largest concentration of fish in each year since 1996 has been in the southwestern portion of Div. 3O extending across the border into Div. 3N (Fig. 6 and 7). From 1985 to 1990, about 80-85% of the stock was located north of 45 degrees, most of which was in Div. 3L (Fig. 8). The proportion north of 45^{o}N declined rapidly after that and since 1993 less than 50% of the biomass has been north of this latitude.

Fall

Stratified-random surveys have been conducted in Div. 3L in the fall from 1981 to 1998, usually in October-November. From 1990 to 1998, fall surveys were also carried out in Div. 3NO. Surveys from 1983 to 1994 were done with the Engel trawl and starting in fall 1995, a Campelen 1800 trawl was used.

Biomass estimates by stratum and depth are given for each Division in Tables 11-13. Biomass estimates with their confidence intervals are shown for the 1998 survey in Table 6. Biomass estimates from the fall survey in 1998 were 48 000, 78 000 and 59 000 t for Div. 3L, 3N and 3O respectively. These values are all higher than the estimates from the

1997 fall survey. In Div. 3N 9 strata were surveyed in 1998 that had not been previously covered in the fall survey. These strata accounted for 1600 t of the total biomass. In Div. 3O there were 6 additional strata surveyed in 1998. No A. plaice were caught in these strata. The overall biomass for Div. 3LNO increased in 1998 over 1997 (Fig. 3). There appears to have been an increasing trend since 1995 with total biomass increasing from 152 000 to 188 000 t from 1995 to 1998. The biomass index remains well below that of 1990 with the 1998 index representing only 30% of that of 1990.

Tables 14-17 and Fig. 5 show the abundance by Division and for Div. 3LNO combined from 1985 to 1998. Abundance and confidence intervals for the 1998 survey are given in Table 6. Conversion of the length based estimates of abundance into age based ones for the fall surveys showed some discrepancies when compared to the original Engel data, when attempted in 1998 (Brodie et al., 1998). These discrepancies have been resolved and since the converted estimates at age are being presented for the first time in this assessment, the original Engel time series for Div. 3LNO combined is given in Table 18. Abundance in Div. 3L and 3O has declined in each year since 1995, while abundance has been increasing in Div. 3N since 1996. Similar to the spring survey, abundance has declined since 1996 for younger fish (ages 0 to 5) but has increased for ages 6+ (Table 17). In 1998, 14% of the population was made up of fish ages 9+ compared to less than 5% in 1996 and 1997. The original Engel data and the converted data show very similar trends, the only difference being that the original Engel data shows a slight decrease in 1+ abundance between 1992 and 1993, while the converted data shows a slight increase in 1+ abundance between these years (Tables 17 & 18).

Plots of distribution by number (Fig. 9) and weight (Fig. 10) for the fall surveys in 1995 to 1998 show that A. plaice are distributed throughout the Div. 3LNO area. However the area of highest concentration is southern 3NO, particularly the southwest edge.

Comparison of Spring and Fall Surveys

Biomass and abundance from the spring and fall surveys can be seen in Figures 3 and 5. Both surveys have shown similar trends in biomass and abundance over the 1990 to 1998 period. However, the fall survey in a given year was always higher than the spring survey of that year (Fig. 11). This pattern is also seen in the 1990-95 surveys using Engel gear (Morgan et al. 1997). This spring to fall increase is seen in Div. 3L during the 1990-96 period but was not consistent before that time (Brodie et al. 1998). One possible explanation for this is that more American plaice may be distributed in deeper water, outside the survey area, in spring compared to fall. Coverage in depths beyond 731 m in spring surveys of Div. 3LNO has been minimal. During the fall surveys in 1996 to 1998, coverage in Div. 3L has been complete out to 1463 m. During these surveys A. plaice were found in depths out to 900 m with few fish beyond that depth.

Abundance at age in both surveys has shown similar trends (Table 10 & 17). In both surveys the number of fish ages 9+ in 1998 is the highest since 1991 but still well below the level of the 1980's.

Catch to RV Biomass ratio

As a proxy for the exploitation rate on this stock, the ratio of catch to biomass from spring RV surveys was examined. Examination of the catch/biomass ratios from Campelen data from 1985 to 1998 (Fig. 12) The Campelen ratios were highest in the 1991-94 period (similar to 1986), and the most recent values (1995-98) are very low, reflecting a period of reduced catches (Table 1).

Mortality

Estimates of total mortality (Z) from the Campelen or equivalent, spring and fall survey data were calculated for ages 1 to 16 (Fig. 13 & 14). A Lowess smoother has been added to the plots to help visualise trends. Both surveys indicate an increase in mortality up to the mid 1990's. Since that time mortality has declined on older ages (5+) but has continued to increase on younger ages, particularly ages 2 to 4.

Weights at age

Mean weights at age were calculated for male and female A. plaice for Div. 3LNO using spring survey data from 1990 to 1998. Means were calculated accounting for the length stratified sampling design. There is some indication of a decline in mean weight at some ages from 1996 to 1998 (Fig. 15). The increase between 1995 and 1996 is likely the result of the conversion of the earlier data to Campelen equivalents (Morgan, In Press).

Maturities

Age and length at 50% maturity were produced from spring RV data. Estimates of proportion mature at each age were also produced for use in spawning stock biomass calculations. Proportion mature at age was calculated according to the method of Morgan and Hoenig (1997) accounting for the length stratified sampling design. For males, A_{50} has been declining since 1985 (Fig. 16). For females, A_{50} has been relatively stable over the time period. The large drop in A_{50} for females between 1995 and 1996 may be at least partly the result of the conversion of the earlier data to Campelen equivalents (Morgan, In Press). For females, analyses of the Engel time series showed that A_{50} had been declining since the late 1970's, and perhaps since the 1960's (Morgan et al., 1996). The current A_{50} for males is 3.8 years and for females it is 8.0 years. This compares to A_{50} in the 1970's of between 6 and 7 years for males and between 11 and 12 years for females.

Estimates of maturity at length are not affected by the conversion of Engel data to Campelen equivalents. Therefore an entire spring time series from 1975 to 1998 is presented (Fig. 17). L_{50} has been declining for both sexes since the early 1980's. The current L_{50} for males is 17.8 cm compared to 25.0 cm in 1980. The current L_{50} for females is 33.0 cm compared to 42 cm in 1980.

Spawning stock biomass

Female spawning stock biomass (SSB) was calculated using spring RV data from 1985 to 1998. The estimates of maturity and mean weight at age described above were used, along with female abundance at age. Before 1990 individual weights were not available and a length-weight relationship (logwt=(3.314*loglen)-5.54) was applied to mean length at age to produce mean weight at age.

SSB declined rapidly from the late 1980's to the early 1990's (Fig. 18). The increase between 1995 and 1996 may be at least in part the result of the conversion of the earlier data (Morgan, In Press). SSB has shown an increase from 35 000 to 45 000 t between 1997 and 1998, but is only 17% of the level of the mid 1980's.

Recruitment

Cohort strengths were estimated using the following model using Campelen or equivalent data from spring RV surveys from 1985 to 1998:

$$\log(N_{ajt}) = t + a_a + d_j + e$$

where: N_{ajt} = number at age a belonging to cohort j in year t

t = intercept

a_a = age effect for ages a=2…5

d_j = cohort effect

e =residuals from the fitted model

This model showed no obvious pattern in the residuals and a significant fit to the data.

R^2=0.84, n=54

Source	DF	Type III SS	F value	Pr>F
AGE	3	67.76	35.14	0.0001
COHORT	16	32.19	3.13	0.0025

The strength of the 1980 to 1996 cohorts was estimated by this model. Cohorts from 1980 to 1986 were generally stronger than those after that period, except for 1994 and 1996 (Fig. 19). The 1994 and 1996 cohorts appear to be above average for the 1980 to 1996 period. The 1996 cohort is represented by only a single data point in the model and the results for this cohort should be treated with caution. An earlier model using only Engel data showed that the cohorts of the early 1980's were weak compared to earlier cohorts (Morgan et al., 1997). Both models show the 1985 cohort to be the strongest in the 1980's. Based on this comparison with the earlier model the 1994 cohort is probably weaker than those of the 1970's.

Stock recruit relationship

The parameter estimates from the above cohort strength model were used to estimate the number of 5 year old fish from the 1985 to 1996 cohorts. A non-parametric analysis of the stock recruit relationship was examined using these estimates as number of recruits and the SSB described above (Evans and Rice, 1988). However, no clear minimum was detected in the jackknifed prediction sums of squares for either the Gaussian or Cauchy weightings. The scatter of recruitment against SSB is shown in Figure 20. There appear to be two scatters of recruitment. One from recent years between 30 000 and 50 000 t of SSB and a second from the 1980's between 225 000 and 300 000 t of SSB. There appears to be little relationship between SSB and recruitment giving little basis for setting a B_{lim} without further analyses.

EU-Spain Surveys

Surveys have been conducted annually from 1995 to 1999 by EU-Spain in the Regulatory Area in Div. 3NO to a maximum depth of 1 462 m (since 1998). Surveys since 1996 are comparable in coverage. Biomass and abundance declined between 1996 and 1997 then increased in 1998 and 1999. In 1999, modal size of males was 28-33 cm, and 36-43 cm for females (Paz, 1999).

Joint FPI – DFO Survey

In the fall of 1998, an industry sponsored survey was conducted for American plaice in NAFO Division 3LNO. The survey used a stratified random design with sets allocated based on area and American plaice abundance. The industry survey and the Canadian fall survey conducted by the Dept. of Fisheries and Oceans showed similar distribution of American plaice with fish being widely distributed throughout Div. 3LNO but most abundant in southern and southwestern 3NO. A full comparison is given in Atkinson et al. (1999).

Virtual Population Analysis

Several formulations of virtual population analyses (VPA) were presented using catch-at-age and survey information up to 1997 (Morgan et. al., 1999). STACFIS agreed that the model that provided the best fit to the data included a natural mortality of 0.6 on all ages from 1989 to 1996 and 0.2 otherwise. An M of 0.6 may be considered high for American plaice. However, the estimates of total mortality from the survey indicate that mortality was very high even during the period of the moratorium (Fig. 13 and 14). As well the adjacent American plaice stock in Div. 2+3K declined by 95% during the late 1980's and early 1990's when catches were extremely low (Bowering et al., 1997). Also, increasing M in the analyses is making an adjustment for unaccounted for deaths, whatever the cause or could account for changes in catchability.

Catch-at-age and weight-at-age as well as the Sum of Products (SOP) from 1993 to 1998 are presented in Table 19. The calculation of catch-at-age for 1993 to 1997 is described in Morgan et al. 1999. For 1998, length frequency data were available from Spain (Div. 3L and 3NO combined, Junquera et al., 1999) and Portugal (Div. 3L, 3N and 3O, Alpoim et

al., 1999). Age length keys from the Canadian spring survey in 1998 were used to derive age compositions which were then combined and adjusted to the total catch.

The ADAPT used catch–at-age for ages 5 to 17 (Table 20) and the Canadian spring survey index for ages 5 to 14 from 1985 to 1998 (Table 10). F at ages 15-17 was set as the average of ages 12-14. M was set at 0.2 except at 0.6 for all ages from 1989 to 1996. Table 21 contains the results. The relative error ranged between 0.26 and 0.36, except for age 6. The residuals in 1985 were all negative and in 1993 they were all positive. The residuals show little trend over time (Fig. 21). On an age by age basis the residuals also show little trend over time (Fig. 22). Both the observed and predicted numbers at age decline until about 1995 or 1997, depending on age (Fig. 23). The 5+ abundance reached its lowest point in 1997 and in 1998 is 10% that of the mid 1970's. Total abundance estimated from the VPA is less than the survey index of abundance. Fishing mortality (Table 21 and Fig. 24) since 1995 is much lower than during the 1970s and 1980s but has shown a slight increase since 1995. Average F on ages 9 to 14 and ages 8 to 12 showed an increasing trend from 1975 to 1992 but has been much lower since 1995. Average F on ages 9 to 14 increased from 0.025 in 1995 to 0.16 in 1998 and on ages 8 to 12 it increased from 0.032 in 1995 to 0.11 in 1998. The high Fs in 1993 and 1994 may be artifacts.

Biomass was calculated by multiplying the weights-at-age in Table 22 by the estimated numbers at age. There were no estimates of weight for some of the oldest ages from 1993 to 1995. These were set as the average of weights at that age from adjacent years. Biomass showed a slight decline over the 1975 to 1985 period but declined rapidly after that (Fig. 24). Biomass has been stable since 1994 at a level that is less than 10% of the average of 1975-1980.

SSB was calculated from 1960 to 1998. The numbers at age and weights at age were available from a previous assessment (Brodie, 1985). For 1960 to 1974 numbers at age 5 were not available. Age 5 numbers were calculated using the number at age 6 and the ratio of age 5 to 6 from the 1975 to 1996 time period. There were no estimates of weight at age 5 prior to 1993. Weight at age 5 from 1960 to 1992 was set as the average of 1993-95. Female maturities at age from the Campelen or equivalent spring survey from 1985 to 1998 were used. For 1960 to 1984, estimates from a model described in Morgan and Brodie (1995) were used. For some of the earliest years there were no estimates for the oldest year classes. These were set as equal to the first estimate for that age. The stock recruit scatter is shown in Figure 25. SSB has been declining since 1986 and is currently at a very low level in the range of 15 000 t. This compares to peak SSBs of over 200 000 t. There appear to be two recruitment regimes. Prior to 1986 recruitment was high over a broad range of SSB. Since 1986 recruitment has been low regardless of SSB. There has been no good recruitment at an SSB of less than 60 000 t.

Assessment

The VPA and the Canadian spring and autumn surveys all show a very large decline in abundance and biomass since about the late-1980s. The EU-Spain survey in the Regulatory Area of Div. 3NO has shown a steady increase in biomass and abundance since 1997. Both the VPA and the survey data indicate that the year classes since the mid-1980s have been weak. The spring survey indicates that the 1994 cohort may be stronger than the average for the 1980 to 1996 period but probably weaker than those of the 1970s. Mortality as estimated on an age by age from the Canadian spring and autumn surveys indicate an increase in mortality up to the mid-1990s. Since that time mortality has declined on older ages (5+) but has continued to increase on younger ages, particularly ages 2 to 4. Most of the indicators evaluated suggest that the stock remains low compared to historic levels.

References

Alpoim, R., E. Santos, J. Vargas, and A. M. Ávila de Melo. 1999. Portuguese research report for 1998. NAFO SCS Doc. 99/16, Ser. No. N4091, 47p.

Atkinson, D.B., M.J. Morgan, W.B. Brodie, B. Smith and G. Gregory. 1999. Results of a 1998 Canadian Industry survey for American plaice in NAFO Divisions 3LNO with comparisons to results from the Canadian fall DFO survey. NAFO SCR Doc. 99/55, Ser. No. N4114, 17p.

Bowering, W.R., M.J. Morgan and W.B. Brodie. 1997. Changes in the population of American plaice (*Hippoglossoides platessoides*) off Labrador and northeastern Newfoundland: a collapsing stock with low exploitation. Fish. Res. 30:199-216.

Brodie, W.B. 1985. An assessment update of the American plaice stock in NAFO Divisions 3LNO. NAFO SCR Doc. 85/51, Ser. No. N1000, 28p.

Brodie, W.B., W.R. Bowering, D. Orr, D. Maddock Parsons, and M.J. Morgan. 1998. An assessment update for American plaice in NAFO Div. 3LNO. NAFO SCR Doc. 98/69, Ser. No. 3061, 30p.

Evans, G.T. and J.C. Rice. 1988. Predicting recruitment from stock size without the mediation of a functional relationship. ICES J. Cons. 44:: 111-122.

Gavaris, S. and W.B. Brodie. 1984. Results of comparative fishing between the *A.T. Cameron* and the *Wilfred Templeman* during July-August 1983. CAFSAC Res. Doc. 84/41, 16p.

Junquera, S. de Cardenas, E., Vazquez, A., and H. Murua. 1999. Spanish research report for 1998. NAFO SCS Doc. 99/6, Ser. No. N4062, 11p.

McCallum, B.R. and S.J. Walsh. 1996. Groundfish Survey trawls used at the Northwest Atlantic Fisheries Centre, 1971-present. NAFO SCR Doc. 96/50, Ser No. N2726, 18p.

Morgan, M.J. IN PRESS. The effect of a change in perception of length distribution of a population on maturity-at-age, weight-at-age, and spawning stock biomass. J. Northw. Atl. Fish. Sci.

Morgan, M.J. and W.B. Brodie. 1995. An assessment of the American plaice stock in Divisions 3LNO. NAFO SCR Doc. 95/62, Ser. No. N2577, 39p.

Morgan, M. J., and J. M. Hoenig. 1997. Estimating maturity-at-age from length stratified sampling. J. Northw. Atl. Fish. Sci., **21**: 51-63.

Morgan, M.J., W.B. Brodie, S.J. Walsh, D. Power and D. Orr. 1996. An assessment of the American plaice stock in Division 3LNO. NAFO SCR Doc. 96/75, Ser. No. N2750, 31 p.

Morgan, M.J., W.B. Brodie, S.J. Walsh, and D. Orr. 1997. An assessment of Divisions 3LNO American plaice. NAFO SCR Doc. 97/60, Ser. No. N2894, 47 p.

Morgan, M.J., W.B. Brodie, W.R. Bowering, D.Maddock Parsons, and D.C. Orr. 1998. Results of Data Conversions for American plaice in Div. 3LNO from Comparative Fishing Trials between the Engel Otter Trawl and the Campelen 1800 Shrimp Trawl. NAFO SCR Doc. 98/70, Ser. No. N3062, 10p.

Morgan, M.J., W.B. Brodie, and D. Maddock Parsons. 1999. Virtual population analyses of the American plaice stock in Div. 3LNO from 1975 to 1997. NAFO SCR Doc. 99/58, Ser. No. N4117, Xp.

Paz, X., and P. Duran. 1999. Results from the 99 Spanish bottom trawl survey in the regulatory area for Divisions 3NO. NAFO SCR Doc. 99/57, Ser. No. N4116, 23p.

Table 1. Nominal catches (t) of American plaice for NAFO Divisions 3LNO, 1960-96 and TACs from 1973 to 1998.

Year	Canada	France	Poland	USSR/Russia	South Korea[a]	Other	Total	TAC
1960	21,352	2,106	-	569	-	20	24,047	-
1961	14,903	1,473	286	1,248	-	3	17,913	-
1962	15,217	973	171	1,841	-	4	18,206	-
1963	24,591	93	457	466	-	112	25,719	-
1964	35,474	1,582	539	680	-	292	38,567	-
1965	45,365	2,056	977	4,544	-	319	53,261	-
1966	51,225	1,246	860	11,484	-	196	65,011	-
1967	54,190	1,326	3,234	35,139	-	524	94,413	-
1968	48,674	406	203	23,751	-	133	73,167	-
1969	64,815	43	34	14,493	-	52	79,437	-
1970	54,929	389	40	10,232	-	1,055	66,645	-
1971	49,394	323	370	17,173	-	628	67,888	-
1972	41,605	322	2,515	14,164	-	755	59,361	-
1973	38,586	310	1,116	12,516	-	315	52,843	60,000
1974	35,101	418	615	10,074	-	89	46,297	60,000
1975	34,015	442	537	7,682	-	545	43,221	60,000
1976	47,806	305	5	3,280	-	429	51,825	47,000
1977	42,579	31	-	1,023	-	348	43,981	47,000
1978	48,634	168	-	1,048	-	178	50,028	47,000
1979	47,131	113	-	1,190	-	135	48,569	47,000
1980	48,296	183	-	336	-	271	49,086	47,000
1981	48,177	210	-	847	-	924	50,158	55,000
1982	49,620	133	-	67	715	517	51,052	55,000
1983	35,907	41	-	170	815	1,602	38,535	55,000
1984	33,756	140	1	360	1,582	3,606[b]	39,445	55,000
1985	40,024	-	4	81	2,483	11,620[b]	54,212	49,000
1986	33,409	46	-	188	3,952	26,975[b]	64,570	55,000
1987	33,967	17	-	47	2,741	18,240	55,012	48,000
1988	26,832	-	-	159	2,522	11,322[b]	40,835	33,585[d]
1989	27,901	92	-	6	725	14,645[b]	43,369	30,300
1990	22,600	-	-	17	1,117	8,767[b]	32,501	24,900
1991	23,240[a]	-	-	60	1,910	9,471[b]	34,681	25,800
1992	10231[a]	-	-	50	518	2,551[b]	13,350	25,800
1993[c]	7,454	-	-	8	13	9,659[b]	17,122	10,500
1994[e]	71	-	-	-	100	7,207[b]	7,378	4.8[f]
1995[c]	59	-	-	-	-	578[b]	637	0
1996[e]	59	-	-	-	-	854[b]	913	0
1997[e]	114	-	-	-	-	1,293[b]	1401	0
1998[e]	212	-	-	10	-	1,396[b]	1618	0
1999[e]								0

[a]Includes a portion of catches reported as unspecified flounder. See text for details.
[b]Includes some catches estimated from surveillance reports.
[c]Catch may have been as high as 19,400.
[d]Effective TAC.
[e]Provisional.
[f]No directed fishing.

Table 2. Breakdown of catches from Table 1 listed as "other" for 1984-98.

Year	Spain	Portugal	Other				Total
			Panama[b]	USA	Caymen Islands[b]	Misc.[a]	
1984	1,622	-	1,800	-	-	184	3,606
1985	5,498	27	3,892	1,310	797	96	11,620
1986	11,882	9,240	3,756	1,506	572	19	26,975
1987	14,476	2,516	-	1,248	-	-	18,240
1988	8,956	872	-	1,379	-	115[c]	11,322
1989	10,909	583	-	1,134	-	2,019[c]	14,645
1990	294	356	-	8	-	8,109[c]	8,767
1991	786	187	-	-	-	8,498[c]	9,471
1992	412	139	-	-	-	2000[c]	2,551
1993	199	92	-	-	-	9368[c]	9659
1994	5476	630	-	575	-	526[c]	7207
1995	430	148	-	-	-	-	578
1996	554	263	-	-	-	37	854
1997	951	336	-	-	-	6	1,293
1998	999	313	-	-	-	84	1,396

[a]Countries not in Tables 1 or 2.
[b]Not reported to NAFO. Catches estimated from surveillance reports.
[c]Includes some estimated catches.

Table 3. Biomass estimates ('000t) of A.plaice, by stratum and depth zone (m), from Canadian spring surveys in Div. 3L in 1996-98 (Campelen). (+) indicates biomass <50 t, (-) means stratum not surveyed.

		Biomass		
Depth	Stratum	Spring 1996	Spring 1997	Spring 1998
30-56	784	-	-	0.2
	Total	-	-	0.2
57-92	350	0.6	0.3	0.3
	363	2.3	0.8	0.0
	371	0.9	0.2	0.1
	372	1.4	0.8	1.3
	384	0.7	0.9	0.2
	785	-	-	0.2
	Total	5.9	3.0	2.1
93-183	328	0.5	0.5	0.1
	341	1.8	0.5	0.7
	342	0.1	0.1	0.4
	343	0.3	0.0	+
	348	1.4	0.8	1.2
	349	0.8	0.3	0.2
	364	2	1.0	0.9
	365	1.1	0.5	0.9
	370	1.3	0.6	1.6
	385	5.6	0.9	0.5
	390	0.6	0.4	0.5
	786	-	-	0.3
	787	-	-	0.5
	788	-	-	-
	790	-	-	-
	793	-	-	-
	794	-	-	-
	797	-	-	-
	799	-	-	-
	Total	15.5	5.5	7.8
184-274	344	1	0.3	0.8
	347	0.6	0.2	0.6
	366	0.4	0.3	0.3
	369	0.3	0.2	0.2
	386	0.5	0.2	0.4
	389	0.4	0.2	0.4
	391	0.3	0.1	0.2
	789	-	-	-
	791*	-	-	-
	795	-	-	-
	798	-	-	-
	Total	3.5	1.5	2.9
275-366	345	0.5	0.2	0.3
	346	0.4	0.3	0.2
	368	0.3	0.0	0.1
	387	0.6	0.6	0.8
	388	0.6	0.2	0.2
	392	0.5	0.1	0.4
	792	-	-	-
	796	-	-	-
	800	-	-	-
	Total	2.9	1.4	2.0
367-549	729	0.2	0.6	2.2
	731	0.5	0.1	+
	733	0.7	0.0	0.3
	735	1.4	1.6	1.2
	Total	2.8	2.4	3.7
550-731	730	+	0.0	0.2
	732	+	0.0	0.0
	734	+	0.0	0.1
	736	+	0.1	0.0
	Total	0.1	0.1	0.3
732-914	737	-	-	-
	741	-	-	-
	745	-	-	-
	748	-	-	-
	Total	-	-	-
915-1097	738	-	-	-
	742	-	-	-
	746	-	-	-
	749	-	-	-
	Total	-	-	-
1098-128	739	-	-	-
	743	-	-	-
	747	-	-	-
	750	-	-	-
	Total	-	-	-
1281-146	740	-	-	-
	744	-	-	-
	751	-	-	-
	Total	-	-	-
Grand Total		30.7	13.8	19.0

* In 1996 had a depth range of 184-366

Table 4. Biomass estimates ('000t) of A.plaice, by stratum and depth zone (m), from Canadian spring surveys in Div. 3N in 1996-98 (Campelen). (+) indicates biomass <50 t, (-) means stratum not surveyed.

		Biomass		
Depth	Stratum	Spring 1996	Spring 1997	Spring 1998
≤ 56	375	2.9	2.2	1.1
	376	0.8	1.8	2.0
	Total	3.7	4.0	3.1
57-92	360	8.8	8.6	7.9
	361	3.8	1.9	2.0
	362	2.8	5.5	4.0
	373	1.6	0.5	0.9
	374	1.1	0.4	0.3
	383	0.5	0.1	+
	Total	18.6	17.0	15.1
93-183	359	1.1	1.1	1.6
	377	0.2	0.1	+
	382	0.1	0.1	0.7
	Total	1.4	1.3	2.3
184-274	358	0.1	0.1	1.4
	378	0.1	0.2	0.2
	381	0.3	0.1	0.1
	Total	0.5	0.4	1.7
275-366	357	0.1	0.1	0.1
	379	+	0.1	0.1
	380	0.2	0.8	0.1
	Total	0.3	1.0	0.3
367-549	723	0.2	0.4	0.3
	725	0.1	0.5	0.2
	727	0.5	2.2	2.0
	Total	0.8	3.1	2.5
550-731	724	0.2	0.5	0.2
	726	+	0.1	+
	728	0.5	-	0.3
	Total	0.7	0.5	0.5

		Biomass		
Depth	Stratum	Spring 199	Spring 199	Spring 1998
732-914	752	-	-	-
	756	-	-	-
	760	-	-	-
	Total			-
915-1097	753	-	-	-
	757	-	-	-
	761	-	-	-
	Total	-	-	-
1098-128	754	-	-	-
	758	-	-	-
	Total	-	-	-
1281-146	755	-	-	-
	759	-	-	-
	Total	-	-	-
Grand Total		26.0	27.4	25.5

Table 5. Biomass estimates ('000t) of A.plaice, by stratum and depth zone (m), from Canadian spring surveys in Div. 3O in 1996-98 (Campelen). (+) indicates biomass <50 t, (-) means stratum not surveyed.

		Biomass		
Depth	Stratum	Spring 1996	Spring 1997	Spring 1998
57-92	330	3.8	0.8	6.9
	331	1.4	0.3	0.3
	338	6.0	5.7	6
	340	2.2	1.7	1.8
	351	2.9	4.4	3.8
	352	9.1	13.8	10.6
	353	7.8	8.3	10.9
	Total	33.2	34.9	40.3
93-183	329	1.6	1.4	4.4
	332	3.9	2.5	3.8
	337	4.6	1.9	3.2
	339	1.4	0.8	0.8
	354	1.6	1.1	5.0
	Total	13.1	7.8	17.2
184-274	333	+	0.3	0.1
	336	0.2	0.3	+
	355	0.5	0.3	0.1
	Total	0.7	0.9	0.2
275-366	334	0.2	0.8	0
	335	0.2	0.2	0
	356	0.1	+	+
	Total	0.5	1.0	+
367-549	717	0.2	1.7	+
	719	0.1	0.5	+
	721	0.2	0.1	+
	Total	0.5	2.2	+
550-731	718	+	0.1	+
	720	+	0.1	+
	722	1.0	4.2	0
	Total	1.0	4.4	+

		Biomass		
Depth	Stratum	Spring 1996	Spring 1997	Spring 1998
732-914	764	-	-	-
	768	-	-	-
	772	-	-	-
	Total	-	-	-
915-1097	765	-	-	-
	769	-	-	-
	773	-	-	-
	Total	-	-	-
Grand Total		49.0	51.2	57.7

Table 6 . Abundance and biomass (total and mean per tow) estimates from 1998 Canadian spring and fall RV surveys in Div. 3L, 3N and 3O. Upper and lower 95% confidence are also shown.

SPRING

3L					
Abundance	Upper	Lower	Mean No./tow	Upper	Lower
133,294,110	155,808,253	110,779,966	24.08	28.15	20.01
Biomass	Upper	Lower	Mean Kg/tow	Upper	Lower
19,527,510	22,919,748	16,135,272	3.53	4.14	2.91
3N					
Abundance	Upper	Lower	Mean No./tow	Upper	Lower
63,205,450	80,697,518	45,713,383	26.32	33.61	19.04
Biomass	Upper	Lower	Mean Kg/tow	Upper	Lower
25,512,113	32,994,252	18,029,974	10.63	13.74	7.51
3O					
Abundance	Upper	Lower	Mean No./tow	Upper	Lower
257,962,891	335,643,931	180,281,850	101.08	131.52	70.64
Biomass	Upper	Lower	Mean Kg/tow	Upper	Lower
58,032,071	69,464,493	46,599649	22.74	27.22	18.26

FALL

3L					
Abundance	Upper	Lower	Mean No./tow	Upper	Lower
292,972,139	347,788,131	238,156,147	45.96	54.56	37.36
Biomass	Upper	Lower	Mean Kg/tow	Upper	Lower
48,887,319	58,016,187	39,758,452	7.67	9.10	6.24
3N					
Abundance	Upper	Lower	Mean No./tow	Upper	Lower
160,503,711	194,467,233	126,540,189	61.25	74.21	48.29
Biomass	Upper	Lower	Mean Kg/tow	Upper	Lower
79,996,717	95,624,654	64,368,779	30.53	36.49	24.56
3O					
Abundance	Upper	Lower	Mean No./tow	Upper	Lower
274,570,006	331,098,955	218,041,056	103.52	124.83	82.21
Biomass	Upper	Lower	Mean Kg /tow	Upper	Lower
58,978,999	71,453,423	46,504,574	22.24	26.94	17.53

Table 7. Abundance index (millions) at age of A. plaice in Canadian spring RV surveys in Div. 3L.

Age/Year	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0.22	0	0	0	0	0	0	0	0	0.232	0	0.108
2	0	1.316	5.233	4.102	1.86	0	1.317	0	0.302	0	0	8.397	0.63	0.683
3	8.105	4.551	11.385	18.835	17.345	5.239	3.225	1.736	2.26	0.356	0.396	29.934	5.438	3.138
4	25.759	23.556	50.302	80.856	80.962	70.172	14.001	5.141	5.752	7.483	0.82	91.963	14.039	10.24
5	146.337	115.406	242.761	279.242	174.034	137.968	110.189	46.07	22.684	31.029	11.843	82.542	31.696	21.1
6	349.774	451.706	566.104	554.371	416.728	231.753	178	61.693	59.147	46.46	17.432	48.498	26.574	36.67
7	513.509	496.697	553.704	501.148	351.418	277.315	102.038	89.331	37.416	44.403	31.753	26.1642	14.58	30.438
8	317.451	260.246	333.722	277.154	208.589	152.334	79.232	33.108	16.714	13.716	31.276	8.009	6.832	19.433
9	152.454	156.89	132.672	188.167	143.331	94.211	43.695	18.531	5.562	6.126	17.628	3.62	2.422	6.38
10	85.188	66.889	65.649	60.044	52.544	55.704	19.021	7.074	2.961	1.382	5.281	0.639	0.688	2.899
11	44.657	27.007	22.235	32.646	26.898	18.397	10.449	2.877	1.231	0.829	1.142	0.085	0.392	1.604
12	22.126	18.069	19.315	20.019	14.771	9.587	6.609	1.444	0.432	0.137	0.209	0.031	0.087	0.64
13	12.337	11.837	9.132	10.111	8.566	6.326	2.567	0.64	0.292	0.147	0.062	0.031	0.021	0.173
14	5.987	4.402	3.933	5.87	4.845	2.4	1.386	0.378	0.127	0.046	0	0	0	0
15	3.053	2.667	2.003	3.694	3.409	2.588	0.989	0.193	0.715	0	0	0	0	0.083
16	1.905	1.575	0.74	1.543	1.066	1.041	0.48	0.064	0.032	0	0	0	0	0.024
17	0.391	0.444	0.242	0.362	0.427	0.58	0.177	0	0.043	0	0	0	0	0
18	0.028	0.216	0.02	0	0.086	0	0.033	0	0	0	0	0	0	0
19	0.028	0	0	0	0.052	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0.1	0	0	0	0	0	0	0
unk1	0.162	0.484	0	0.03	0	2.016	0.033	0.012	0	0	0	0	0	0.036
total	1689.251	1643.958	2019.372	2038.194	1506.931	1067.631	573.541	268.292	155.67	152.114	117.842	300.1452	103.399	133.649

Table 8. Abundance index (millions) at age of A. plaice in Canadian spring RV surveys in Div. 3N.

Age/Year	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0.257	0	0	0	0	0.274	0	0	0	0	0	0	0	0.065
2	2.327	2.522	17.272	3.673	4.372	4.297	0.432	0.414	0.777	0	0	2.058	0.152	0.236
3	33.52	13.39	72.322	45.692	49.061	29.604	2.538	3.146	3.844	1.243	0.737	6.009	1.514	0.236
4	109.113	46.724	113.729	87.966	312.984	165.098	30.462	24.496	74.104	4.097	4.078	6.009	4.278	2.999
5	60.974	106.132	84.599	62.943	106.444	282.873	117.508	38.481	75.444	29.509	14.993	15.582	5.459	3.99
6	60.72	72.839	57.121	27.629	38.678	35.977	75.697	51.692	68.227	12.913	13.294	26.374	16.84	6.124
7	30.063	41.094	32.024	17.231	17.284	11.605	12.848	22.658	54.035	12.314	8.385	20.447	24.415	11.919
8	25.109	17.896	18.644	13.306	18.085	8.027	5.616	5.577	30.272	7.684	4.622	6.893	15.659	19.735
9	20.17	14.527	16.042	11.159	14.707	8.855	5.639	2.673	9.349	4.181	2.454	3.878	5.92	12.515
10	20.347	13.206	11.423	8.693	6.771	5.085	5.466	1.254	4.179	1.295	0.81	0.844	1.702	4.963
11	15.375	7.298	6.89	4.895	5.228	3.998	3.407	1.037	2.677	1.024	0.277	0.535	0.862	2.069
12	9.115	6.106	5.348	3.565	4.337	2.642	1.965	0.723	1.408	0.22	0.048	0.868	0.515	0.802
13	4.804	4.162	4.464	2.954	3.7	2.236	1.77	0.274	0.513	0.45	0	0.139	0.202	0.453
14	2.927	2.173	3.364	2.001	2.694	2.209	1.159	0.328	0.523	0.596	0	0.069	0.035	0.177
15	2.386	2.363	3.875	1.996	2.96	2.338	1.179	0.452	0.264	0.341	0	0.15	0.035	0.062
16	0.708	1.268	1.67	0.913	1.106	1.426	0.667	0.298	0.25	0.17	0	0	0	0.061
17	0.192	0.978	0.66	0.788	0.958	0.794	0.525	0.029	0.181	0	0	0	0	0
18	0	0.181	0.382	0.285	0.427	0.37	0.23	0.03	0.054	0	0	0	0	0
19	0	0.05	0.053	0.063	0.106	0.092	0.088	0	0.046	0	0	0	0	0
20	0	0	0.027	0	0	0.098	0.111	0.094	0	0	0	0	0	0
unk1	0.257	0	0	0	0.026	0.463	0	0.321	0.031	0	0	0.07	0	0
total	398.364	352.909	449.909	295.752	589.928	568.361	267.307	153.977	326.178	76.037	49.698	89.925	77.588	66.406

Table 9. Abundance index (millions) at age of A. plaice in Canadian spring RV surveys in Div. 3O.

Age/Year	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0.262	0	0	0	0	0	0	0	0	0.114	0.08	0.371
2	0	0.579	5.378	0.693	0	5.445	0	4.088	1.298	0	0	35.87	5.788	8.827
3	8.596	13.378	16.946	15.845	20.367	10.615	24.859	28.664	3.391	0.936	0.886	63.899	33.35	7.293
4	24.121	39.55	57.584	22.467	51.186	113.04	39.651	30.2	40.669	9.534	6.219	27.8141	36.803	39.43
5	56.5	34.464	132.854	26.427	55.665	197.908	170.493	25.725	39.926	38.682	15.078	35.5544	28.123	44.707
6	44.057	36.816	124.229	34.621	96.359	110.171	110.458	76.756	52.763	46.667	26.798	55.641	40.988	26.402
7	52.08	39.365	70.478	25.496	101.467	82.081	65.319	38.926	68.613	28.655	19.745	50.511	40.316	34.386
8	47.238	28.916	45.948	24.512	47.051	39.903	28.068	24.718	42.463	21.87	14.039	24.609	26.227	40.223
9	35.383	22.234	35.925	18.523	29.599	27.413	18.21	12.916	17.315	9.685	7.402	8.691	10.602	29.014
10	34.703	18.022	24.029	16.555	15.364	16.735	10.703	9.175	9.37	2.72	2.248	3.019	3.657	11.698
11	24.265	11.65	12.704	11.087	7.717	9.99	8.404	5.533	3.718	2.099	1.245	1.322	1.424	6.255
12	13.958	10.203	9.135	8.991	7.963	9.234	4.782	3.235	2.424	1.039	0.282	1.334	1.217	1.839
13	5.575	5.736	6.332	5.68	4.559	5.866	2.887	2.429	0.978	0.644	0.031	0.348	0.339	0.998
14	5.063	2.328	3.839	4.098	2.111	4.2	2.984	1.061	0.675	0.354	0.035	0.181	0.139	0.268
15	4	2.295	3.025	2.36	2.192	2.041	1.886	1.778	0.485	0.133	0	0.102	0.127	0.411
16	1.585	0.917	1.834	2.307	1.817	1.705	1.031	1.251	0.554	0.09	0	0.168	0.127	0.051
17	0.375	0.722	0.968	1.14	1.066	1.222	1.998	0.781	0.362	0	0	0	0	0.035
18	0.03	0.179	0.461	0.508	0.427	0.547	0.441	0.514	0.087	0	0	0	0	0
19	0	0.05	0.196	0.032	0.026	0.219	0.241	0.131	0.082	0	0	0	0	0
20	0.288	0	0	0.031	0.026	0	0.083	0.129	0.05	0	0	0	0	0
unk1	0	0	0	0	0.268	0	1.042	0.328	0.393	0.044	0	0.046	0	0.104
total	357.817	267.404	552.127	221.373	445.23	638.335	493.54	268.338	285.616	163.152	94.008	309.2235	229.307	252.312

Table 10. Abundance index (millions) at age of A. plaice in Canadian spring RV surveys in Div. 3LNO.

Age/Year	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1	0.26	0.00	0.48	0.00	0.00	0.27	0.00	0.00	0.00	0.00	0.00	0.35	0.08	0.54
2	2.33	4.42	27.88	8.47	6.23	9.74	1.75	4.50	2.38	0.00	0.00	46.33	6.57	9.75
3	50.22	31.32	100.65	80.37	86.77	45.46	30.62	33.55	9.50	2.54	2.02	99.84	40.30	10.67
4	158.99	109.83	221.62	191.29	445.13	348.31	84.11	59.84	120.53	21.11	11.12	125.79	55.12	52.67
5	263.81	256.00	460.21	368.61	336.14	618.75	398.19	110.28	138.05	99.22	41.91	133.68	65.28	69.80
6	454.55	561.36	747.45	616.62	551.77	377.90	364.16	190.14	180.14	106.04	57.52	130.51	84.40	69.20
7	595.65	577.16	656.21	543.88	470.17	371.00	180.21	150.92	160.06	85.37	59.88	97.12	79.31	76.74
8	389.80	307.06	398.31	314.97	273.73	200.26	112.92	63.40	89.45	43.27	49.94	39.51	48.72	79.39
9	208.01	193.65	184.64	217.85	187.64	130.48	67.54	34.12	32.23	19.99	27.48	16.19	18.94	47.91
10	140.24	98.12	101.10	85.29	74.68	77.52	35.19	17.50	16.51	5.40	8.34	4.50	6.05	19.56
11	84.30	45.96	41.83	48.63	39.84	32.39	22.26	9.45	7.63	3.95	2.66	1.94	2.68	9.93
12	45.20	34.38	33.80	32.58	27.07	21.46	13.36	5.40	4.26	1.40	0.54	2.23	1.82	3.28
13	22.72	21.74	19.93	18.75	16.83	14.43	7.22	3.34	1.78	1.24	0.09	0.52	0.56	1.62
14	13.98	8.90	11.14	11.97	9.65	8.81	5.53	1.77	1.33	1.00	0.04	0.25	0.17	0.45
15	9.50	7.33	8.90	8.71	8.56	6.97	5.48	2.96	1.46	0.47	0.00	0.25	0.16	0.56
16	4.20	3.76	4.24	4.76	3.99	4.17	2.18	1.61	0.84	0.26	0.00	0.17	0.13	0.14
17	0.89	2.14	1.87	1.63	2.45	2.60	1.28	0.27	0.59	0.00	0.00	0.00	0.00	0.00
18	0.06	0.58	0.86	0.79	0.94	0.92	0.70	0.54	0.14	0.00	0.00	0.00	0.00	0.00
19	0.03	0.10	0.25	0.10	0.18	0.31	0.33	0.13	0.13	0.00	0.00	0.00	0.00	0.00
20	0.29	0.00	0.03	0.03	0.03	0.10	0.29	0.22	0.05	0.00	0.00	0.00	0.00	0.00
unk1	0.42	0.48	0.00	0.03	0.29	2.48	1.08	0.66	0.42	0.04	0.00	0.12	0.00	0.14
Ages 0+	2445.01	2263.79	3021.41	2555.29	2541.80	2271.85	1333.31	689.95	767.04	391.26	261.55	699.18	410.29	452.19
Ages 6+	1969.40	1862.22	2210.56	1906.55	1667.52	1249.32	818.64	481.79	496.59	268.39	206.50	293.20	242.94	308.77
Ages 9+	529.40	416.64	408.59	431.08	371.86	300.15	161.36	77.33	66.94	33.71	39.15	26.05	30.51	83.44
Ages 12+	96.86	78.92	81.02	79.31	69.70	59.76	36.37	16.26	10.58	4.37	0.67	3.42	2.84	6.04

Table 11. Biomass estimates ('000t) of A.plaice, by stratum and depth zone (m), from Canadian fall surveys in Div. 3L in 1995-98 (Campelen).
(+) indicates biomass <50 t, (-) means stratum not surveyed.

		Biomass			
Depth	Stratum	Fall 1995	Fall 1996	Fall 1997	Fall 1998
30-56	784	-	+	+	0
	Total	-	+	+	0
57-92	350	0.8	0.9	0.5	1.1
	363	3.1	2	1.4	2.1
	371	1.2	1.1	0.2	0.5
	372	1.4	1.6	1.5	0.3
	384	1.6	1.6	0.5	0.2
	785	-	+	+	+
	Total	8.1	7.2	4.0	4.2
93-183	328	3.0	1.6	0.9	0.5
	341	1.6	2.8	0.8	2.1
	342	0.6	+	0.4	0.2
	343	0.7	0.1	0.0	0.1
	348	3.1	1.8	1.3	1.5
	349	3.4	1.4	1.5	0.8
	364	2.8	3.6	2.8	5.2
	365	1.7	1.1	1.0	1.4
	370	2.0	6.3	1.3	4.6
	385	3.9	7.6	1.9	4
	390	1.7	1.6	2.2	3.3
	786	-	0.3	0.1	0.1
	787	-	0.4	0.5	0.1
	788	-	0.3	0.3	0.1
	790	-	0.2	0.2	+
	793	-	0.1	0.1	0.1
	794	-	+	0.1	+
	797	-	0.1	0.1	+
	799	-	0.1	0.1	+
	Total	24.5	29.4	15.6	24.1
184-274	344	1.0	1.1	0.1	0.5
	347	1.8	0.7	0.3	0.8
	366	1.6	1.2	0.5	0.8
	369	1.0	1.6	0.5	1.8
	386	1.8	2.6	1.0	0.9
	389	0.6	0.6	0.6	0.7
	391	0.4	0.2	0.2	0.2
	789	-	0.2	0.2	0.1
	791*	-	0.5	0.4	0.1
	795	-	+	0.2	0.4
	798	-	0.2	0.7	0.3
	Total	8.2	8.9	4.6	6.6
275-366	345	4.1	2.4	0.8	2.5
	346	2.8	1.1	2.2	1.7
	368	0.2	0.3	0.2	0.4
	387	0.4	0.7	0.7	0.2
	388	0.3	0.1	0.4	+
	392	+	+	0.2	0.1
	796	-	0.6	0.9	0.4
	800	-	-	-	0.2
	Total	7.8	5.4	7.4	5.5

		Biomass			
Depth	Stratum	Fall 1995	Fall 1996	Fall 1997	Fall 1998
367-549	729	+	+	0.2	0.1
	731	0.2	-	0.6	0.1
	733	0.2	0.2	0.5	0.6
	735	0.7	0.7	0.3	0.8
	792	-	0.2	1.9	0.3
	Total	1.1	1.1	3.6	1.9
550-731	730	+	0	0.5	0.1
	732	+	+	1.3	0.2
	734	0	0.2	0.3	0.1
	736	0.2	0.5	0.8	0.6
	Total	0.2	0.7	2.8	1.0
732-914	737	0.4	1.5	1.8	3.3
	741	-	1.0	2.3	1.7
	745	-	0.1	2.2	0.1
	748	-	1.4	0.7	0.0
	Total	0.4	4.0	7.0	5.1
915-1097	738	0.6	0.2	0.0	0.0
	742	-	0.1	0.0	0.0
	746	-	0.1	0.0	+
	749	-	+	0.2	0.0
	Total	0.6	0.4	0.2	+
1098-1280	739	-	0.0	0.0	0.0
	743	-	0.0	0.0	0.0
	747	-	0.0	0.0	0.1
	750	-	0.1	0.0	0.0
	Total	-	0.1	0.0	0.1
1281-1463	740	-	0.0	0.0	0.0
	744	-	0.5	0.0	0.1
	751	-	0.0	0.0	0.0
	Total	-	0.5	0.0	0.1
Grand Total		50.9	57.7	45.2	48.6

* in 1996 stratum 791 covered a depth range of 184-366 m

Table 12. Biomass estimates ('000t) of A.plaice, by stratum and depth zone (m), from Canadian fall surveys in Div. 3N in 1995-98 (Campelen). (+) indicates biomass <50 t, (-) means stratum not surveyed.

Biomass

Depth	Stratum	Fall 1995	Fall 1996	Fall 1997	Fall 1998
≤ 56	375	1.9	1.1	3.9	5.2
	376	4.7	2.4	7.7	4.4
	Total	6.6	3.5	11.6	9.6
57-92	360	22.3	7.4	28.4	39.2
	361	3.5	4.1	3.3	2.1
	362	5.0	1.1	5.1	2.9
	373	1.8	0.2	2.3	1.7
	374	2.4	0.4	1.8	1.3
	383	-	0.3	0.5	0.8
	Total	35.0	13.5	41.4	48.0
93-183	359	2.2	0.3	3.8	11.6
	377	0.5	0.4	2.3	1.1
	382	0.3	0.3	0.8	6.1
	Total	3.0	1.0	6.9	18.8
184-274	358	0.8	0.2	0.4	0.3
	378	0.1	0.2	0.1	0.1
	381	0.1	0.4	0.2	0.1
	Total	1.0	0.8	0.7	0.5
275-366	357	0.1	0.1	0.0	+
	379	+	0.2	0.1	+
	380	0.1	0.2	0.1	0.1
	Total	0.2	0.5	0.2	0.1
367-549	723	+	+	0.0	0.1
	725	0.1	0.1	0.0	+
	727	+	0.1	0.1	0.1
	Total	0.1	0.2	0.2	0.2
550-731	724	0.1	0.3	0.0	0.0
	726	+	0.3	0.1	+
	728	+	0.8	0.1	0.1
	Total	0.1	1.4	0.2	0.1
732-914	752	-	-	-	1.5
	756	-	-	-	0.1
	760	-	-	-	0.0
	Total				1.6
915-1097	753	-	-	-	+
	757	-	-	-	0.0
	761	-	-	-	0.0
	Total	-	-	-	+
1098-128	754	-	-	-	0.0
	758	-	-	-	0.0
	Total	-	-	-	0.0
1281-146	755	-	-	-	0.0
	759	-	-	-	0.0
	Total	-	-	-	0.0
Grand Total		46.0	20.9	61.0	78.9

Table 13. Biomass estimates ('000t) of A.plaice, by stratum and depth zone (m), from Canadian fall surveys in Div. 3O in 1995-98 (Campelen). (+) indicates biomass <50 t, (-) means stratum not surveyed.

Biomass

Depth	Stratum	Fall 1995	Fall 1996	Fall 1997	Fall 1998
57-92	330	7.7	0.8	5.5	5.9
	331	1.2	0.3	0.9	1.8
	338	6.6	3.3	6.4	3.4
	340	7.2	0.4	3.2	1.1
	351	1.7	0.9	5.2	3.3
	352	4.6	9.1	6.9	8.4
	353	5.6	14.4	14.8	19.3
	Total	34.6	29.2	42.9	43.2
93-183	329	3.2	1.5	2.7	5.0
	332	3.5	3.9	1.6	3.9
	337	2.4	25.3	2.5	1.5
	339	6.5	0.9	5.1	1.4
	354	4.5	8.0	2.4	3.7
	Total	20.1	39.6	14.4	15.5
184-274	333	+	-	+	+
	336	+	0.1	0.1	+
	355	0.2	5.4	0.1	+
	Total	0.2	5.5	0.2	+
275-366	334	0.0	-	+	+
	335	+	+	+	+
	356	0.0	0.1	+	+
	Total	+	0.1	0.1	+
367-549	717	0.0	-	+	0.0
	719	+	0.2	0.0	+
	721	+	0.6	0.0	0.0
	Total	+	0.8	+	+
550-731	718	0.0	-	0.0	+
	720	0.0	+	-	+
	722	0.0	+	0.0	0.0
	Total	0.0	+	0.0	+

Depth	Stratum	Fall 1995	Fall 1996	Fall 1997	Fall 1998
732-914	764	-	-	-	0.0
	768	-	-	-	0.0
	772	-	-	-	0.0
	Total	-	-	-	0.0
915-1097	765	-	-	-	0.0
	769	-	-	-	0.0
	773	-	-	-	0.0
	Total	-	-	-	0.0
Grand Total		54.9	75.2	57.5	58.7

Table 14. Abundance index (millions) at age for A. plaice in Div. 3L from Canadian fall RV surveys. Data from 1990 to 1994 are Campelen equivalents

Age/Year	1990	1991	1992	1993	1994	1995	1996	1997	1998
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09
1	0.78	0.12	0.00	0.00	0.00	0.45	1.12	0.17	2.71
2	2.39	2.09	0.75	3.10	0.00	11.05	16.62	1.52	3.84
3	26.07	14.38	12.54	21.10	0.00	25.11	57.94	21.44	6.89
4	309.25	91.21	52.65	71.20	14.48	59.35	170.16	63.91	28.35
5	597.38	295.78	171.91	123.36	25.75	198.76	149.44	105.70	64.67
6	548.02	372.37	269.73	218.20	42.96	187.22	84.67	84.48	90.34
7	303.10	164.87	102.93	138.57	54.51	101.25	31.85	35.87	57.37
8	145.95	77.59	32.27	27.74	28.54	36.23	6.04	10.59	25.21
9	95.12	43.16	10.42	7.96	8.82	19.26	2.46	5.73	14.46
10	36.73	18.31	5.51	2.65	1.88	3.65	0.83	1.27	3.74
11	17.48	8.27	1.87	1.13	0.29	0.36	0.14	0.82	1.26
12	9.06	5.12	1.63	0.29	0.06	0.10	0.06	0.19	0.41
13	5.46	1.95	0.46	0.09	0.02	0.00	0.05	0.14	0.06
14	3.94	1.51	0.26	0.07	0.07	0.00	0.00	0.00	0.00
15	1.52	0.88	0.12	0.24	0.00	0.00	0.00	0.01	0.00
16	0.51	0.23	0.04	0.06	0.00	0.00	0.00	0.00	0.00
17	0.00	0.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
unk	0.31	0.01	0.00	0.00	0.00	1.51	0.00	0.50	0.27
total	2103.06	1098.06	663.07	615.76	177.38	644.28	521.37	332.31	299.68

Table 15. Abundance index (millions) at age for A. plaice in Div. 3N from Canadian fall surveys. Data from 1990 to 1994 are Campelen equivalents.

Age/Year	1990	1991	1992	1993	1994	1995	1996	1997	1998
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1	2.34	0.82	5.84	0.00	0.00	1.97	0.11	1.81	1.93
2	40.24	84.64	78.12	1.90	0.00	17.53	1.70	1.34	1.38
3	134.78	193.91	161.07	52.32	16.51	15.09	4.08	8.06	0.86
4	295.80	284.75	130.72	283.60	65.29	16.40	3.31	14.95	11.62
5	169.59	288.82	130.17	135.26	96.33	27.70	9.34	8.33	18.51
6	30.73	72.35	131.01	67.76	43.86	62.43	13.60	29.97	11.44
7	9.34	19.55	53.35	74.65	23.60	15.42	12.65	41.44	25.97
8	3.83	10.86	12.33	23.64	14.33	9.03	4.55	24.91	35.67
9	6.62	10.35	8.02	8.78	7.29	6.09	1.82	8.00	37.85
10	3.31	7.24	3.71	4.70	1.97	2.21	0.79	3.60	8.76
11	2.53	5.98	2.20	2.20	0.78	0.72	0.36	1.64	3.54
12	1.71	3.26	1.74	1.65	1.00	0.71	0.27	0.43	1.21
13	1.60	4.31	1.45	0.88	0.42	0.25	0.00	0.49	0.61
14	1.53	2.50	1.23	0.78	0.69	0.02	0.00	0.34	0.52
15	1.49	1.45	0.33	0.66	0.29	0.00	0.06	0.15	0.08
16	1.59	1.05	0.46	0.34	0.00	0.00	0.00	0.04	0.24
17	0.47	0.48	0.29	0.10	0.00	0.00	0.00	0.00	0.13
18	0.13	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	0.00	0.04	0.00	0.03	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
unk	0.16	0.06	1.73	0.21	0.09	0.07	0.00	0.19	0.12
total	707.78	992.55	723.78	659.44	272.46	175.66	52.65	145.70	160.43

Table 16. Abundance index (millions) at age for A. plaice in Div. 3O from Canadian fall RV surveys. Data from 1990 to 1994 are Campelen equivalents.

Age/Year	1990	1991	1992	1993	1994	1995	1996	1997	1998
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.61
1	8.24	0.63	0.00	0.00	0.00	35.77	2.28	1.32	17.60
2	10.51	12.10	2.58	5.10	0.00	97.32	80.15	16.68	21.30
3	25.25	56.20	44.10	42.54	3.02	20.35	74.47	71.61	9.03
4	100.36	73.88	74.88	143.08	23.98	35.12	54.27	67.87	77.71
5	86.13	139.80	65.85	101.84	68.22	69.48	49.52	39.82	37.99
6	64.11	134.09	98.45	86.11	64.26	86.70	75.81	45.40	27.31
7	57.19	64.96	69.79	103.34	56.80	35.29	37.70	42.67	29.30
8	41.89	27.82	32.12	52.74	46.38	16.19	10.77	17.73	22.54
9	22.78	28.33	17.21	16.26	12.54	14.17	4.54	9.60	16.11
10	15.16	18.75	8.47	7.97	3.97	4.89	1.46	2.43	5.45
11	9.19	11.66	4.38	3.47	1.60	0.80	1.29	0.76	2.14
12	6.66	5.48	3.48	3.15	0.67	0.50	0.26	0.59	2.01
13	4.99	5.96	1.43	2.11	0.48	0.20	0.05	0.22	1.37
14	3.85	2.96	1.67	1.53	0.41	0.28	0.12	0.26	0.32
15	2.41	2.12	0.70	0.79	0.10	0.05	0.28	0.31	0.10
16	2.36	1.05	0.67	0.96	0.00	0.00	0.00	0.03	0.14
17	1.17	0.33	0.24	0.18	0.00	0.00	0.00	0.00	0.31
18	0.08	0.28	0.27	0.31	0.00	0.00	0.00	0.00	0.05
19	0.00	0.11	0.06	0.19	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
unk	0.17	1.31	0.13	1.45	0.00	0.00	0.00	0.37	0.81
total	462.49	587.83	426.46	573.11	282.41	417.10	392.95	317.68	273.20

Table 17. Abundance index (millions) at age for A. plaice in Div. 3LNO from Canadian fall RV surveys. Data from 1990 to 1994 are Campelen equivalents.

Age/Year	1990	1991	1992	1993	1994	1995	1996	1997	1998
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.70
1	11.36	1.56	5.84	0.00	0.00	38.19	3.52	3.30	22.23
2	53.13	98.83	81.45	10.10	0.00	125.90	98.46	19.54	26.52
3	186.10	264.49	217.71	115.95	19.53	60.55	136.49	101.12	16.78
4	705.41	449.84	258.26	497.88	103.74	110.88	227.74	146.72	117.67
5	853.10	724.40	367.93	360.45	190.30	295.94	208.29	153.85	121.17
6	642.86	578.81	499.19	372.08	151.09	336.35	174.08	159.85	129.09
7	369.63	249.38	226.08	316.57	134.91	151.96	82.20	119.98	112.64
8	191.67	116.27	76.71	104.12	89.25	61.45	21.37	53.22	83.42
9	124.52	81.84	35.65	33.00	28.65	39.52	8.82	23.33	68.42
10	55.20	44.30	17.68	15.32	7.82	10.75	3.08	7.30	17.95
11	29.20	25.92	8.45	6.80	2.67	1.88	1.78	3.22	6.94
12	17.43	13.86	6.85	5.10	1.72	1.31	0.59	1.21	3.63
13	12.05	12.21	3.33	3.08	0.92	0.45	0.10	0.85	2.04
14	9.32	6.98	3.15	2.38	1.17	0.31	0.12	0.60	0.84
15	5.42	4.45	1.15	1.68	0.40	0.05	0.35	0.48	0.18
16	4.45	2.34	1.17	1.36	0.00	0.00	0.00	0.08	0.38
17	1.64	1.00	0.52	0.27	0.00	0.00	0.00	0.00	0.45
18	0.21	0.42	0.27	0.31	0.00	0.00	0.00	0.00	0.05
19	0.00	0.17	0.06	0.22	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
unk	0.64	1.38	1.86	1.65	0.09	1.58	0.00	1.05	1.20
Ages 0+	3272.68	2677.06	1811.45	1846.66	732.15	1235.46	966.97	794.63	732.11
Ages 6+	1463.58	1137.94	880.27	862.28	418.59	604.02	292.47	370.11	426.03
Ages 9+	259.43	193.48	78.29	69.52	43.34	54.26	14.83	37.06	100.88
Ages 12+	50.51	41.42	16.50	14.40	4.21	2.12	1.15	3.20	7.57

Table 18. Abundance index (millions) at age of A. plaice in Canadian fall RV surveys in Div. 3LNO. Data are original Engel estimates.

Age\Year	1990	1991	1992	1993	1994
1	0.6	0.04	0.3	0.00	0
2	2.8	5.4	4.34	0.55	0
3	10.3	14.6	12.9	6.77	1.16
4	42.82	26.88	17	33.66	8.3
5	72.85	62.83	29.8	32.07	22.6
6	85.08	68.49	65.4	40.83	23.4
7	97.79	54.71	50.7	55.87	27.3
8	75.86	42.82	29.3	33.03	23.3
9	61.75	39.14	17.1	15.62	12.4
10	29.72	23.27	9.4	8.27	3.89
11	15.81	14.19	4.7	3.69	1.51
12	9.41	7.69	3.7	2.78	0.93
13	6.7	6.7	1.9	1.68	0.51
14	5	3.8	1.7	1.30	0.64
15	2.9	2.5	0.7	0.92	0.26
16	2.5	1.3	0.72	0.74	0
17	0.9	0.56	0.3	0.15	0
1+	522.79	374.92	249.96	237.92	126.2
6+	393.42	265.17	185.62	164.88	94.14
9+	134.69	99.15	40.22	35.15	20.14
12+	27.41	22.55	9.02	7.56	2.34

Table 19. Catch numbers at age and weight at age as well as the catch weight at age (SOP) for Div. 3LNO A. plaice from 1993 to 1998.

	Numbers (000)					
	93	**94**	**95**	**96**	**97**	**98**
2						
3		79	3	15	2	
4	761	356	14	35	10	3
5	1172	4316	99	181	33	11
6	3713	3837	314	743	275	55
7	8821	5426	453	975	853	273
8	11591	4460	333	453	853	767
9	5720	2777	203	211	422	805
10	3377	737	65	52	146	455
11	1853	476	14	10	91	279
12	1002	163	4	8	54	117
13	527	121		2	24	69
14	355	55		1	1	49
15	246	18		1	1	16
16	127	10				3
17	94					
18	37					
19	15					
20	6					
21	1					
UNK		52	2	11	25	2

	Weights (kg)					
	93	**94**	**95**	**96**	**97**	**98**
2						
3		0.053	0.064	0.103	0.059	
4	0.067	0.067	0.065	0.120	0.123	0.206
5	0.114	0.119	0.179	0.148	0.164	0.169
6	0.225	0.193	0.237	0.210	0.242	0.167
7	0.275	0.266	0.330	0.296	0.336	0.269
8	0.365	0.374	0.438	0.451	0.486	0.365
9	0.496	0.533	0.709	0.657	0.652	0.504
10	0.589	0.757	1.034	0.918	0.844	0.615
11	0.729	0.897	1.605	1.083	0.990	0.770
12	0.912	1.127	1.676	1.323	1.302	0.980
13	1.227	1.484		1.576	1.771	1.220
14	1.438	1.701		2.907	2.349	1.694
15	1.868	2.272		2.618	2.349	1.630
16	2.339	2.178				2.352
17	2.432					
18	3.614					
19	3.794					
20	4.031					
21	3.549					

	SOP (t)						
	93	**94**	**95**	**96**	**97**	**98**	
2	0	0	0	0	0	0	
3	0	4	0	2	0	0	
4	51	24	1	4	1	1	
5	134	512	18	27	5	2	
6	835	739	74	156	67	9	
7	2424	1441	150	289	287	73	
8	4225	1666	146	204	415	280	
9	2836	1479	144	139	275	405	
10	1988	558	68	48	123	280	
11	1350	426	22	11	90	214	
12	914	183	7	11	71	115	
13	646	179	0	4	42	84	
14	510	93	0	3	3	83	
15	460	40	0	3	3	25	
16	297	21	0	0	0	6	
17	229	0	0	0	0	0	
18	135	0	0	0	0	0	
19	56	0	0	0	0	0	
20	24	0	0	0	0	0	
21	3	0	0	0	0	0	
	17120	7367	630	899	1382	1579	Total SOP(t)
	17122	7378	637	913	1407	1618	Catch used(t)

Table 20. Catch at age for Div. 3LNO A. plaice from 1975 to 1998.

	5	6	7	8	9	10	11	12	13	14	15	16	17
1975	883.0	3128.0	7220.0	9433.0	9234.0	7903.0	5701.0	4732.0	3788.0	2617.0	1461.0	763.0	475.0
1976	837.0	3907.0	8781.0	19363.0	16597.0	12338.0	8323.0	5156.0	3024.0	2309.0	1347.0	584.0	245.0
1977	974.0	6723.0	8743.0	11730.0	13559.0	11157.0	6520.0	4257.0	2369.0	1493.0	1000.0	342.0	182.0
1978	1558.0	4467.0	9195.0	10397.0	12743.0	13881.0	9938.0	6823.0	3655.0	2239.0	1472.0	649.0	212.0
1979	1257.0	6551.0	13532.0	18747.0	14977.0	12506.0	8791.0	3775.0	1843.0	714.0	342.0	159.0	63.0
1980	263.0	2977.0	9531.0	12578.0	14111.0	14212.0	11288.0	8088.0	3732.0	1565.0	645.0	265.0	87.0
1981	154.0	554.0	2248.0	4786.0	7921.0	11425.0	13565.0	11872.0	8693.0	5591.0	2938.0	1119.0	394.0
1982	27.0	314.0	1814.0	4799.0	8946.0	12836.0	15801.0	14489.0	7942.0	4224.0	2000.0	641.0	206.0
1983	119.0	991.0	3053.0	5797.0	8343.0	7707.0	8493.0	7517.0	4588.0	2480.0	1219.0	373.0	130.0
1984	48.0	397.0	1516.0	3311.0	5853.0	9958.0	12887.0	8964.0	5072.0	2515.0	1090.0	404.0	93.0
1985	296.0	788.0	2362.0	5652.0	10694.0	15741.0	14528.0	9233.0	4108.0	1969.0	1235.0	388.0	160.0
1986	4407.0	9707.0	12556.0	12530.0	13372.0	13874.0	14246.0	10376.0	5947.0	2637.0	1416.0	542.0	162.0
1987	2237.0	4941.0	7691.0	10893.0	15867.0	17640.0	11404.0	6986.0	3076.0	1303.0	768.0	247.0	27.0
1988	2908.0	3213.0	4853.0	7269.0	10123.0	10325.0	9260.0	6040.0	2692.0	1156.0	656.0	267.0	38.0
1989	12745.0	11553.0	11432.0	9652.0	14180.0	12387.0	8405.0	4972.0	2029.0	1027.0	550.0	146.0	14.0
1990	15134.0	7694.0	4489.0	4604.0	8666.0	8666.0	6452.0	3633.0	1702.0	945.0	453.0	80.0	12.0
1991	6103.0	12152.0	7846.0	9331.0	7856.0	6589.0	4394.0	2294.0	811.0	364.0	246.0	172.0	56.0
1992	148.0	1023.0	2591.0	3395.0	3618.0	2154.0	1507.0	875.0	576.0	513.0	269.0	171.0	90.0
1993	1172.4	3712.9	8820.9	11590.5	5720.0	3376.9	1853.1	1002.5	526.9	354.7	246.4	127.2	94.2
1994	4316.3	3837.1	5426.1	4459.7	2777.0	736.9	475.6	162.8	120.9	54.7	17.7	9.8	0.1
1995	99.2	313.9	453.2	333.0	203.3	65.5	13.6	4.1	0.1	0.1	0.1	0.1	0.1
1996	180.9	742.8	975.0	452.7	211.1	51.9	10.4	8.1	2.3	1.0	1.0	0.1	0.1
1997	33.4	274.8	852.7	853.1	421.6	146.0	91.4	54.2	23.9	1.3	1.3	0.1	0.1
1998	10.6	54.8	272.7	767.1	804.9	455.5	278.5	117.3	69.0	49.2	15.5	2.5	0.1

Table 21 . Results of VPA using catch from 1975 to 1998 ages 5 to 17. Canadian spring survey 1985 to 1998 ages 5 to 14. M=0.2 except M=0.6 on all ages from 1989 to 1996.

APPROXIMATE STATISTICS ASSUMING LINEARITY NEAR SOLUTION

ORTHOGONALITY OFFSET..... 0.001242
MEAN SQUARE RESIDUALS 0.232395

		Parameters in linear scale PAR. EST.	STD. ERR	REL. ERR	BIAS	REL. BIAS
6-15 survivors on Jan 1 1999	6	2.97E+04	1.50E+04	0.503	3.85E+03	0.13
	7	1.91E+04	6.84E+03	0.358	1.28E+03	0.067
	8	1.87E+04	5.57E+03	0.298	8.63E+02	0.046
	9	1.03E+04	2.90E+03	0.281	3.95E+02	0.038
	10	6.21E+03	1.71E+03	0.276	2.12E+02	0.034
	11	3.38E+03	8.78E+02	0.26	1.00E+02	0.03
	12	1.79E+03	4.61E+02	0.257	5.02E+01	0.028
	13	8.18E+02	2.13E+02	0.261	2.57E+01	0.031
	14	3.97E+02	1.07E+02	0.271	1.33E+01	0.034
	15	1.20E+02	3.48E+01	0.29	4.84E+00	0.04
5-14 slopes or catchabilities (q)	5	2.12E-03	3.07E-04	0.145	1.60E-05	0.008
	6	3.89E-03	5.42E-04	0.139	2.76E-05	0.007
	7	5.02E-03	6.85E-04	0.137	3.63E-05	0.007
	8	4.65E-03	6.30E-04	0.136	3.57E-05	0.008
	9	4.13E-03	5.58E-04	0.135	3.33E-05	0.008
	10	3.17E-03	4.28E-04	0.135	2.67E-05	0.008
	11	3.05E-03	4.13E-04	0.135	2.80E-05	0.009
	12	3.70E-03	5.03E-04	0.136	3.71E-05	0.01
	13	4.19E-03	5.73E-04	0.137	4.54E-05	0.011
	14	5.45E-03	7.53E-04	0.138	6.41E-05	0.012

residuals

age	5	6	7	8	9	10	11	12	13	14
1985.5	-0.394	-0.273	-0.018	-0.107	-0.292	-0.102	-0.031	-0.176	-0.196	-0.175
1986.5	-0.307	-0.011	-0.033	-0.327	-0.359	-0.342	-0.555	-0.258	0.020	-0.368
1987.5	0.354	0.391	0.159	-0.012	-0.322	-0.229	-0.569	-0.318	-0.003	0.216
1988.5	-0.085	0.261	0.062	-0.221	-0.153	-0.370	-0.294	-0.341	-0.353	-0.006
1989.5	-0.038	0.167	0.224	-0.047	-0.032	-0.288	-0.344	-0.194	-0.310	-0.503
1990.5	0.527	0.156	0.200	0.185	0.162	0.330	-0.012	-0.058	0.203	-0.216
1991.5	0.604	0.105	-0.096	-0.111	0.142	0.216	0.350	0.132	-0.209	0.048
1992.5	-0.383	-0.102	-0.329	-0.275	-0.261	0.131	0.150	0.026	-0.145	-0.747
1993.5	0.055	0.148	0.253	0.198	0.316	0.543	0.930	0.876	0.541	0.509
1994.5	-0.188	-0.146	-0.061	0.028	0.044	0.074	0.553	0.897	2.335	2.126
1995.5	-0.804	-0.696	-0.298	0.243	0.553	0.335	0.238	-0.724	-0.857	0.488
1996.5	0.487	0.343	0.210	0.003	-0.122	-0.352	-0.462	0.490	-0.275	0.487
1997.5	0.173	-0.171	0.034	0.070	-0.148	-0.393	-0.386	-0.273	-0.554	-1.216
1998.5	0.000	-0.173	-0.308	0.372	0.471	0.446	0.432	-0.079	-0.197	-0.642

Table 21. Continued

Bias adjusted population numbers ('000)

	5	6	7	8	9	10	11	12	13	14	15	16	17	5
1975	291320.0	228786.1	191819.8	123411.8	75155.9	43358.9	25837.4	15968.5	10983.1	6172.0	3298.2	1662.9	1328.8	1019103.4
1976	277500.4	237715.1	184489.3	150531.4	92532.4	53211.2	28386.8	16027.6	8827.1	5597.1	2713.3	1394.9	680.1	1059606.6
1977	231833.0	226442.1	191096.4	143122.1	105797.8	60821.2	32474.6	15770.9	8498.1	4516.5	2517.3	1020.2	619.8	1024529.8
1978	216599.8	188929.0	179325.4	148565.5	106599.0	74402.6	39755.3	20722.6	9089.0	4830.6	2359.1	1166.1	528.6	992872.6
1979	203241.7	175929.7	150648.6	138521.1	112255.7	75791.7	48424.3	23619.3	10848.3	4171.2	1955.7	625.9	377.3	946410.5
1980	202593.1	165264.9	138125.5	111137.9	96522.1	78413.7	50793.5	31734.6	15938.7	7222.7	2772.3	1293.4	369.6	902182.0
1981	191838.6	165631.7	132619.1	104489.3	79655.1	66315.8	51408.9	31436.7	18715.6	9694.9	4506.1	1690.0	820.6	858822.2
1982	197590.1	156925.0	135107.3	106549.3	81229.0	58074.6	44010.2	29905.7	15107.9	7561.2	2967.4	1087.2	393.1	836508.0
1983	202033.6	161748.7	128195.7	108978.3	82903.8	58440.8	36005.7	21876.4	11556.9	5294.1	2432.7	660.3	320.6	820447.8
1984	207753.5	165303.6	131533.6	102201.1	83992.5	60354.1	40903.5	21845.1	11173.3	5356.3	2120.4	904.7	208.9	833650.6
1985	203767.9	170050.8	134980.5	106321.4	80686.1	63487.1	40448.3	21929.1	9866.9	4617.6	2140.1	764.6	379.8	839440.2
1986	183497.1	166563.7	138514.1	108379.7	81948.1	56425.3	37834.3	20100.6	9697.9	4404.4	2020.2	654.4	280.1	810319.8
1987	169195.4	146255.5	127611.8	102083.4	77440.7	55053.8	33729.6	18219.7	7210.1	2662.4	1264.2	403.5	62.1	741192.0
1988	209982.3	136505.2	115283.3	97540.2	73759.2	49130.5	29253.2	17392.4	8662.8	3153.1	1017.4	353.3	111.1	742144.0
1989	229713.4	169292.7	108859.9	90005.6	73302.2	51269.4	30938.4	15644.4	8826.6	4677.4	1546.1	251.7	54.4	784382.3
1990	240993.8	116803.0	84517.7	51461.8	42405.0	30028.7	19264.3	10975.5	5050.5	3389.2	1829.9	459.0	37.9	607216.3
1991	140969.6	121262.6	58513.0	43120.0	24903.6	17044.3	10300.0	5992.9	3443.8	1564.0	1185.5	680.0	194.3	429173.3
1992	101418.0	72924.7	57743.7	26441.3	16965.8	8080.0	4704.0	2566.7	1669.3	1308.7	597.4	473.9	250.1	295143.5
1993	82203.0	55551.4	39276.0	29805.2	12056.2	6712.8	2895.0	1510.3	788.0	507.7	356.4	139.5	139.0	231940.6
1994	77104.4	44259.1	27789.9	15226.9	8179.8	2624.6	1337.0	331.9	152.5	77.4	41.4	30.5	0.1	177155.6
1995	57633.1	39177.7	21506.4	11348.8	5177.6	2519.1	914.5	396.9	68.8	5.3	6.0	10.3	9.8	138774.2
1996	49996.6	31557.3	21272.2	11472.7	5985.8	2693.6	1334.8	492.0	214.9	37.7	2.8	3.2	5.6	125069.0
1997	26691.8	27306.7	16777.8	10965.1	5966.8	3131.4	1440.4	724.9	264.1	116.2	19.9	0.9	1.7	93407.8
1998	31620.1	21823.3	22108.7	12966.9	8208.0	4504.9	2432.0	1096.9	544.6	194.7	94.0	15.2	0.6	105609.7
1999	43000.0	25878.8	17817.9	17854.8	9924.3	5994.4	3277.6	1740.1	792.3	383.7	115.2	63.0	10.2	126852.2

Bias adjusted fishing mortalities

	5	6	7	8	9	10	11	12	13	14	15	16	17
1975	0.003	0.015	0.042	0.088	0.145	0.224	0.278	0.393	0.474	0.622	0.661	0.694	0.496
1976	0.003	0.018	0.054	0.153	0.220	0.294	0.388	0.434	0.470	0.599	0.778	0.611	0.501
1977	0.005	0.033	0.052	0.095	0.152	0.225	0.249	0.351	0.365	0.449	0.570	0.457	0.388
1978	0.008	0.026	0.058	0.080	0.141	0.229	0.321	0.447	0.579	0.704	1.127	0.928	0.577
1979	0.007	0.042	0.104	0.161	0.159	0.200	0.223	0.193	0.207	0.209	0.214	0.327	0.203
1980	0.001	0.020	0.079	0.133	0.175	0.222	0.280	0.328	0.297	0.272	0.295	0.255	0.299
1981	0.001	0.004	0.019	0.052	0.116	0.210	0.342	0.533	0.706	0.984	1.222	1.258	0.741
1982	0.000	0.002	0.015	0.051	0.129	0.278	0.499	0.751	0.849	0.934	1.303	1.021	0.844
1983	0.001	0.007	0.027	0.060	0.117	0.157	0.300	0.472	0.569	0.715	0.789	0.951	0.585
1984	0.000	0.003	0.013	0.036	0.080	0.200	0.423	0.595	0.684	0.717	0.820	0.668	0.665
1985	0.002	0.005	0.019	0.060	0.158	0.318	0.499	0.616	0.607	0.627	0.985	0.804	0.616
1986	0.027	0.066	0.105	0.136	0.198	0.315	0.531	0.825	1.093	1.048	1.411	2.155	0.989
1987	0.015	0.038	0.069	0.125	0.255	0.432	0.462	0.543	0.627	0.762	1.075	1.090	0.644
1988	0.015	0.026	0.048	0.086	0.164	0.262	0.426	0.478	0.416	0.513	1.197	1.671	0.469
1989	0.076	0.095	0.149	0.153	0.292	0.379	0.436	0.531	0.357	0.338	0.614	1.292	0.409
1990	0.087	0.091	0.073	0.126	0.311	0.470	0.568	0.559	0.572	0.450	0.390	0.260	0.527
1991	0.059	0.142	0.194	0.333	0.526	0.687	0.790	0.678	0.368	0.362	0.317	0.400	0.469
1992	0.002	0.019	0.061	0.185	0.327	0.426	0.536	0.581	0.590	0.701	0.855	0.626	0.624
1993	0.019	0.093	0.348	0.693	0.925	1.014	1.566	1.693	1.721	1.906	1.859	6.280	1.773
1994	0.077	0.122	0.296	0.479	0.578	0.454	0.614	0.974	2.758	1.964	0.792	0.538	1.899
1995	0.002	0.011	0.028	0.040	0.053	0.035	0.020	0.014	0.002	0.025	0.023	0.013	0.014
1996	0.005	0.032	0.063	0.054	0.048	0.026	0.010	0.022	0.014	0.036	0.606	0.042	0.024
1997	0.001	0.011	0.058	0.090	0.081	0.053	0.072	0.086	0.105	0.012	0.075	0.139	0.068
1998	0.000	0.003	0.014	0.067	0.114	0.118	0.135	0.125	0.150	0.325	0.200	0.200	0.200

Table 22. Mean weight at age for Div. 3LNO A. plaice as calculated from the commercial fishery from 1960 to 1998.

	5	6	7	8	9	10	11	12	13	14	15	16	17
1960	0.137	0.193	0.274	0.363	0.487	0.594	0.695	0.857	0.903	1.193	1.262	1.308	1.411
1961	0.137	0.187	0.279	0.373	0.493	0.596	0.741	0.865	0.888	1.199	1.264	1.324	1.423
1962	0.137	0.177	0.276	0.38	0.522	0.611	0.738	0.885	0.905	1.206	1.272	1.33	1.423
1963	0.137	0.227	0.297	0.384	0.525	0.621	0.731	0.845	0.867	1.152	1.255	1.541	1.872
1964	0.137	0.285	0.378	0.491	0.547	0.639	0.76	0.851	0.92	1.208	1.289	1.596	1.921
1965	0.137	0.289	0.365	0.498	0.625	0.703	0.827	0.869	0.932	1.258	1.377	1.614	1.905
1966	0.137	0.277	0.369	0.499	0.64	0.788	0.976	0.988	0.984	1.287	1.413	1.656	1.922
1967	0.137	0.287	0.383	0.469	0.61	0.788	0.847	1.03	1.064	1.369	1.631	1.89	2.166
1968	0.137	0.276	0.348	0.45	0.602	0.697	0.851	0.991	1.075	1.397	1.597	1.881	2.197
1969	0.137	0.29	0.332	0.412	0.564	0.67	0.785	0.982	1.05	1.401	1.602	1.87	2.24
1970	0.137	0.275	0.33	0.397	0.536	0.68	0.795	0.841	1.043	1.166	1.311	1.673	1.854
1971	0.137	0.259	0.331	0.404	0.494	0.612	0.772	0.909	1.034	1.132	1.279	1.6	1.911
1972	0.137	0.278	0.372	0.484	0.527	0.629	0.753	0.867	0.935	1.175	1.38	1.654	1.854
1973	0.137	0.244	0.292	0.38	0.519	0.629	0.816	1.041	1.243	1.334	1.524	1.816	1.939
1974	0.137	0.252	0.339	0.416	0.568	0.694	0.917	1.108	1.36	1.567	1.922	2.387	2.458
1975	0.137	0.254	0.348	0.417	0.564	0.692	0.896	1.077	1.318	1.523	1.777	2.254	2.538
1976	0.137	0.261	0.346	0.414	0.557	0.66	0.829	1.017	1.142	1.347	1.661	2.05	2.263
1977	0.137	0.264	0.357	0.43	0.614	0.672	0.878	1.018	1.231	1.415	1.782	2.191	2.323
1978	0.137	0.26	0.353	0.412	0.512	0.614	0.768	0.917	1.184	1.38	1.694	2.066	2.276
1979	0.137	0.322	0.374	0.453	0.551	0.609	0.702	0.934	1.228	1.688	1.91	2.117	2.336
1980	0.137	0.328	0.408	0.482	0.541	0.57	0.65	0.739	0.982	1.355	1.758	1.793	2.224
1981	0.137	0.379	0.406	0.453	0.487	0.536	0.551	0.676	0.792	1.005	1.305	1.772	2.116
1982	0.137	0.298	0.36	0.427	0.485	0.533	0.596	0.739	0.976	1.275	1.594	2.028	2.322
1983	0.137	0.382	0.473	0.555	0.658	0.698	0.697	0.756	0.959	1.22	1.551	2.132	2.37
1984	0.137	0.314	0.382	0.46	0.551	0.563	0.654	0.852	1.128	1.444	1.987	2.561	2.851
1985	0.137	0.329	0.43	0.473	0.549	0.655	0.82	1.102	1.472	1.898	2.341	2.904	3.27
1986	0.137	0.194	0.277	0.411	0.548	0.666	0.776	0.989	1.296	1.674	2.065	2.518	3.03
1987	0.137	0.293	0.398	0.439	0.497	0.655	0.843	1.103	1.395	1.735	2.221	2.952	3.345
1988	0.137	0.254	0.343	0.446	0.489	0.601	0.774	1.034	1.369	1.745	2.226	2.825	3.645
1989	0.137	0.186	0.261	0.388	0.488	0.608	0.806	1.068	1.446	1.805	2.259	2.992	3.885
1990	0.137	0.246	0.345	0.445	0.554	0.704	0.913	1.205	1.624	1.992	2.206	2.788	3.422
1991	0.137	0.31	0.418	0.483	0.608	0.788	1.014	1.334	1.812	2.177	2.193	2.659	3.057
1992	0.137	0.284	0.352	0.413	0.548	0.732	0.941	1.184	1.494	1.8	2.127	2.507	2.988
1993	0.114	0.225	0.275	0.365	0.496	0.589	0.729	0.912	1.227	1.438	1.868	2.339	2.432
1994	0.119	0.193	0.266	0.374	0.533	0.757	0.897	1.127	1.484	1.701	2.272	2.178	2.71
1995	0.179	0.237	0.330	0.438	0.709	1.034	1.605	1.676	1.53	2.304	2.445	2.265	2.71
1996	0.148	0.210	0.296	0.451	0.657	0.918	1.083	1.323	1.576	2.907	2.618	2.265	2.71
1997	0.164	0.242	0.336	0.486	0.652	0.844	0.990	1.302	1.771	2.349	2.349	2.265	2.71
1998	0.169	0.167	0.269	0.365	0.504	0.615	0.770	0.980	1.220	1.694	1.630	2.352	2.71

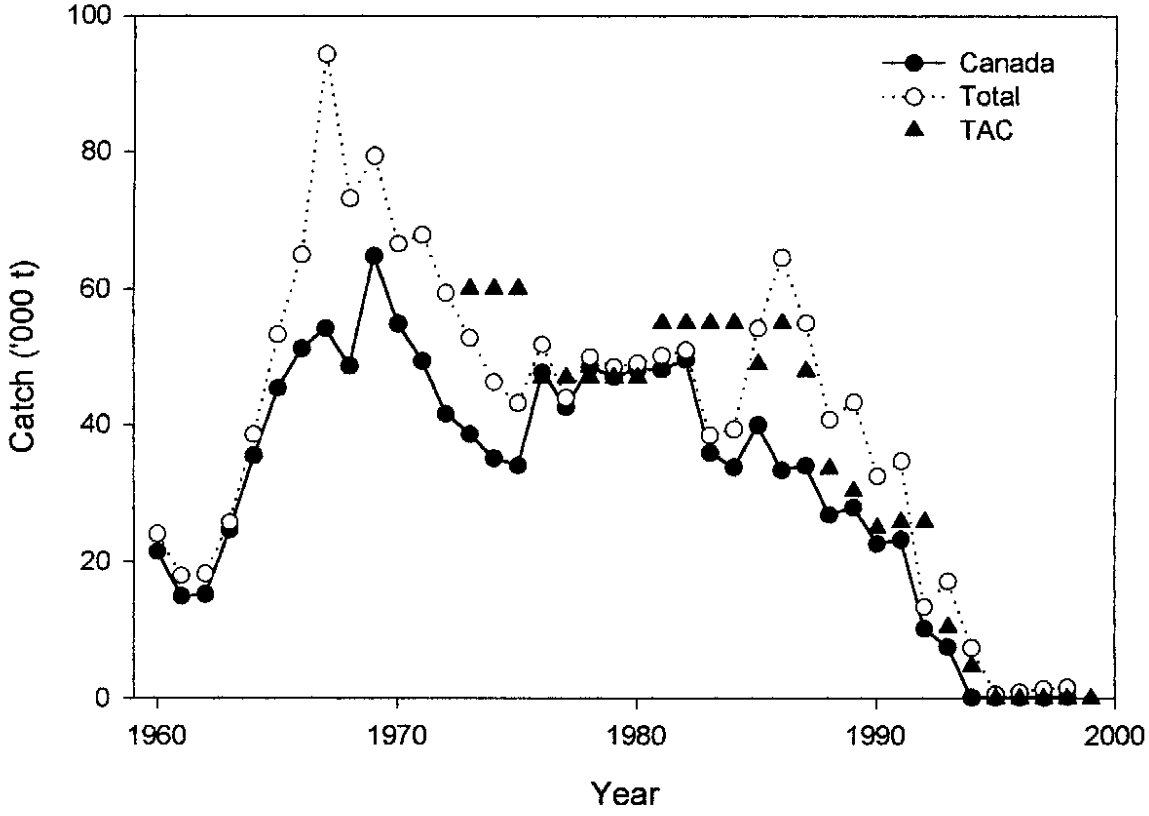


Figure 1. Catches and TAC's of American plaice in Div. 3LNO.

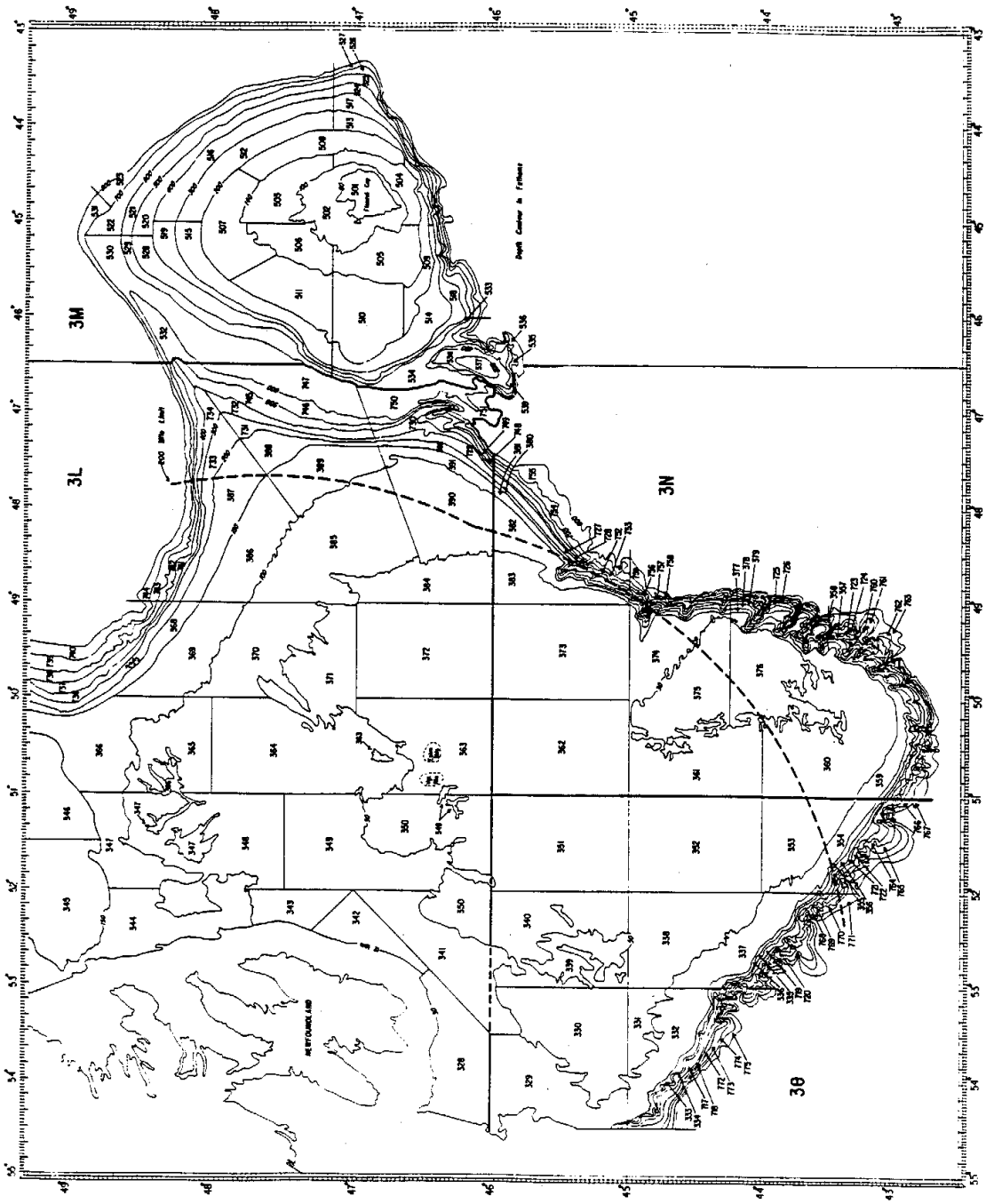


Figure 2. NAFO Div. 3LMNO, showing the Canadian 200 mile limit as well as the stratification scheme used in Canadian groundfish surveys.

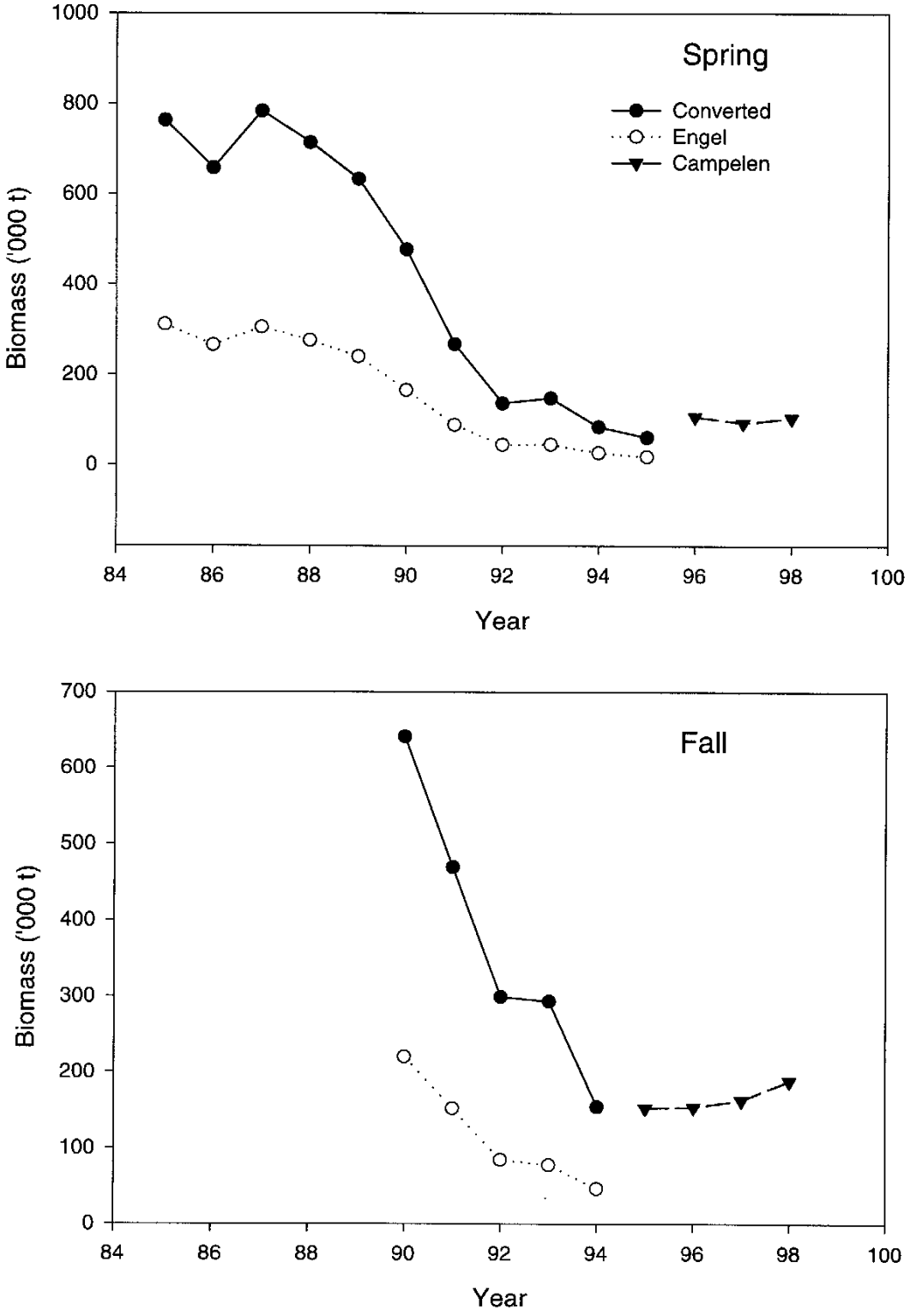
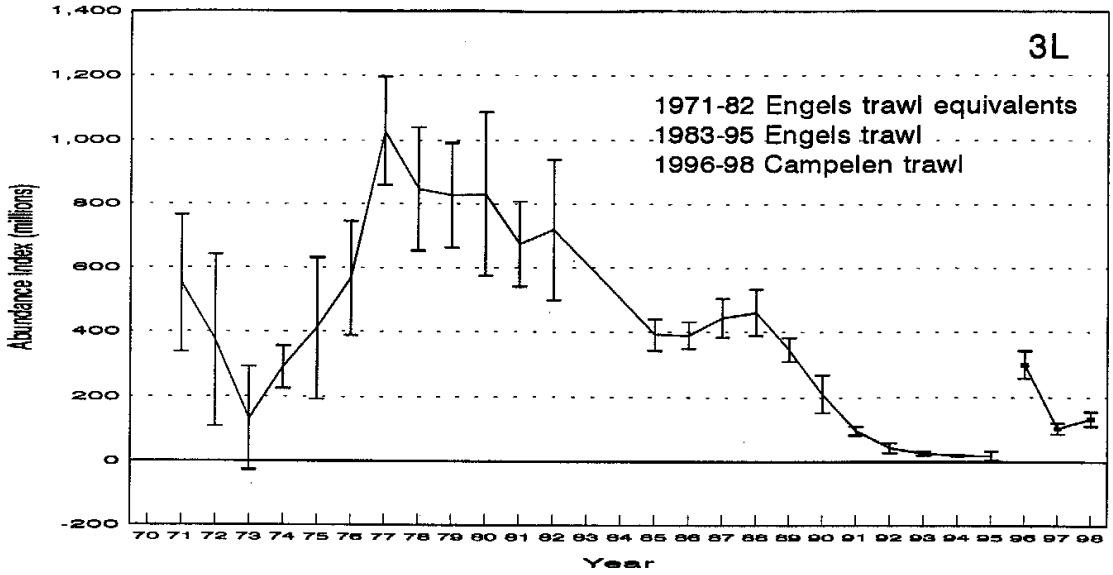
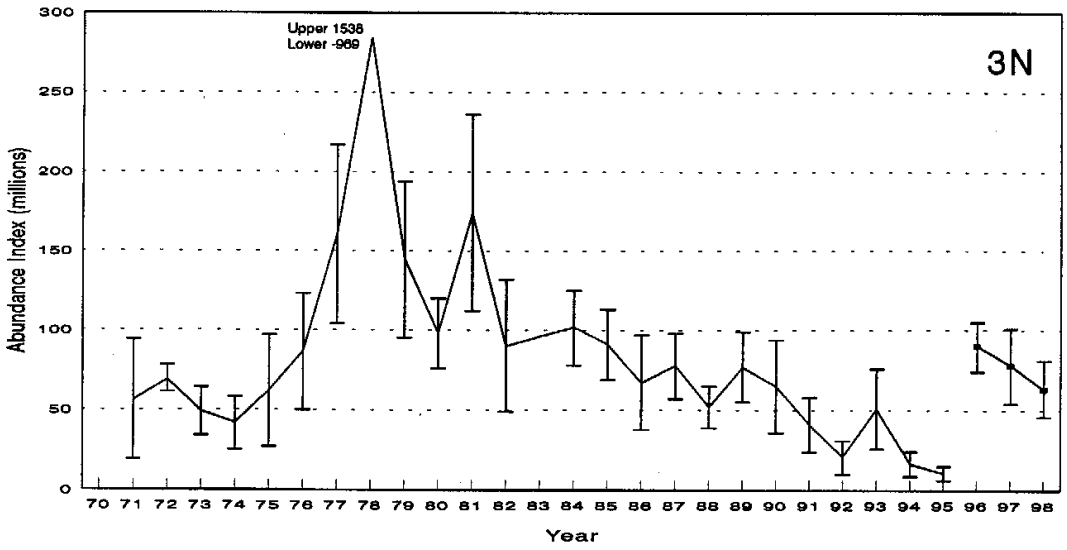


Figure 3. Biomass ('000 tons) of American plaice from spring and fall Canadian surveys in Div. 3LNO combined.





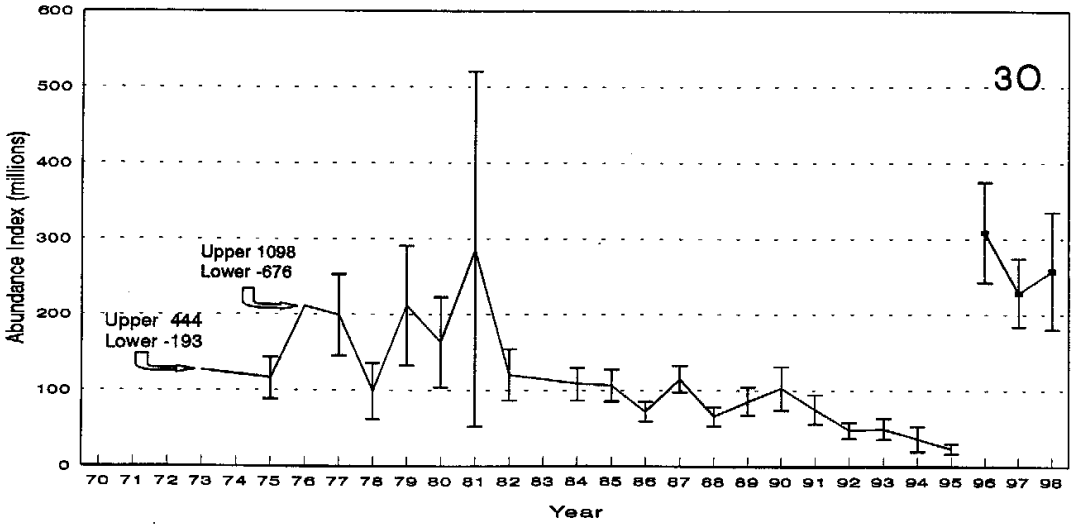


Fig. 4 Abundance estimates of A.plaice (with approx. 95% C.I.) from Canadian spring surveys in Div. 3L, 3N, and 3O.

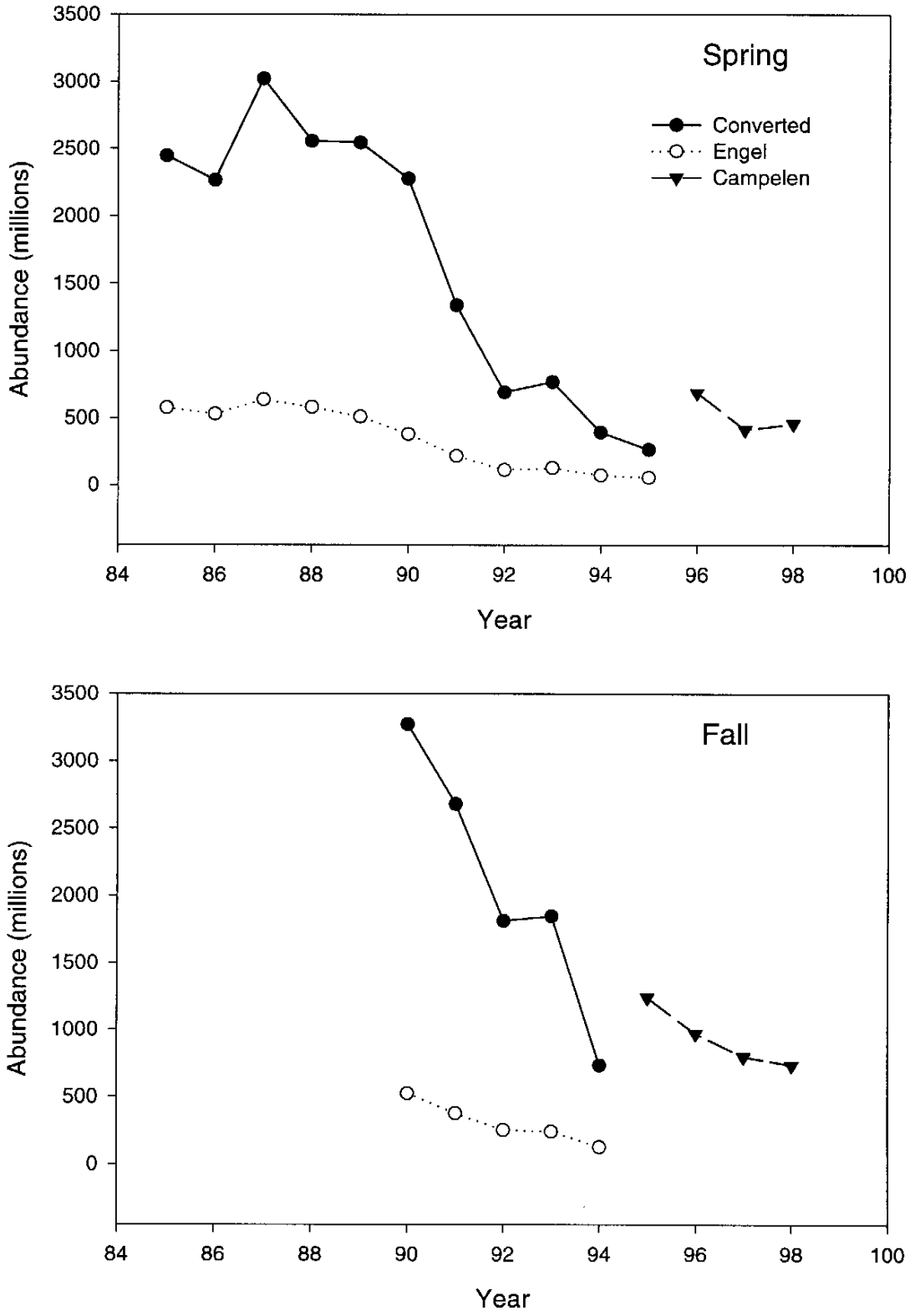


Figure 5. Abundance (millions) of American plaice from spring and fall Canadian surveys in Div. 3LNO combined.

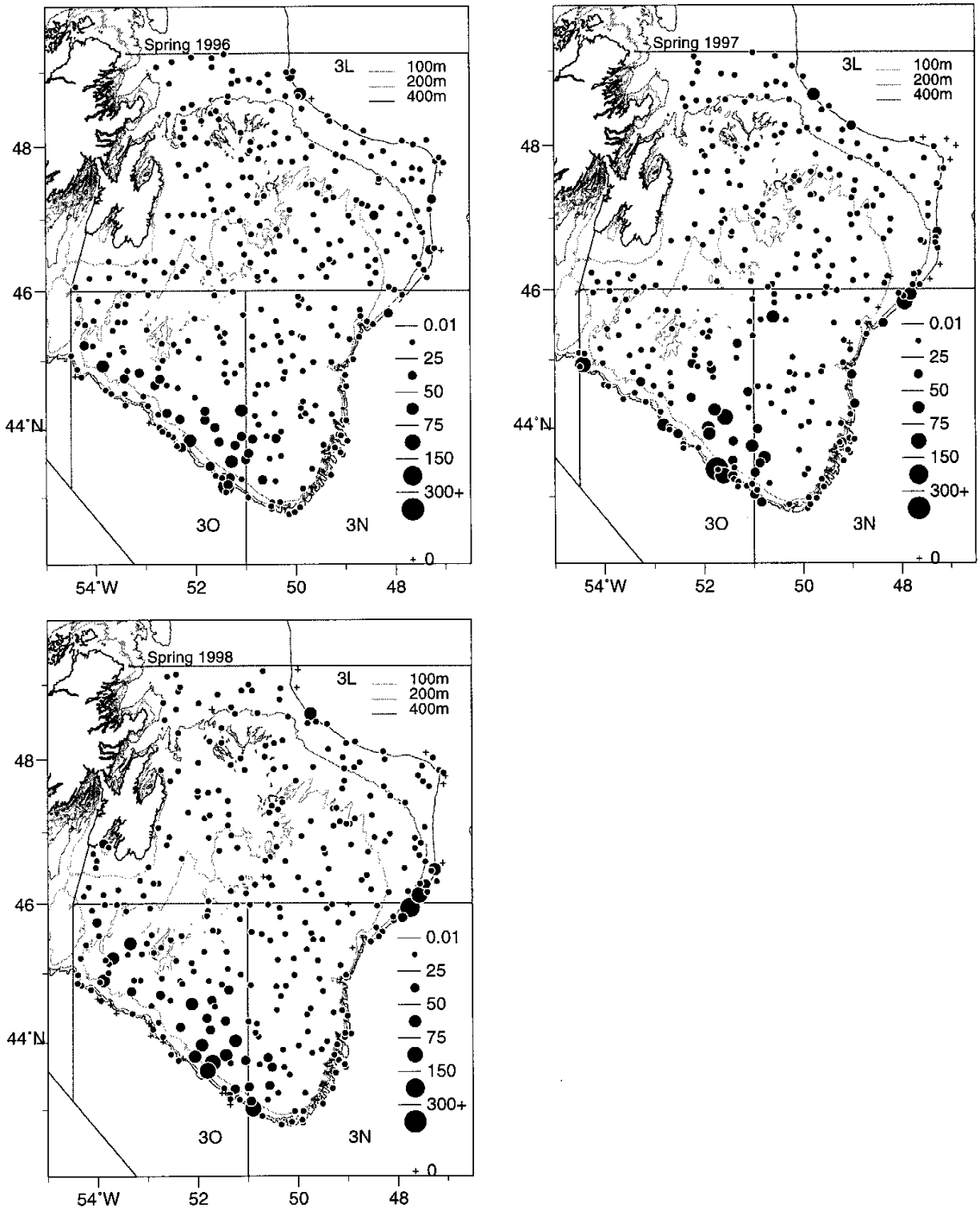


Fig. 6 Distribution of American plaice (kg) from Canadian spring surveys in NAFO Divisions 3LNO from 1996-98.

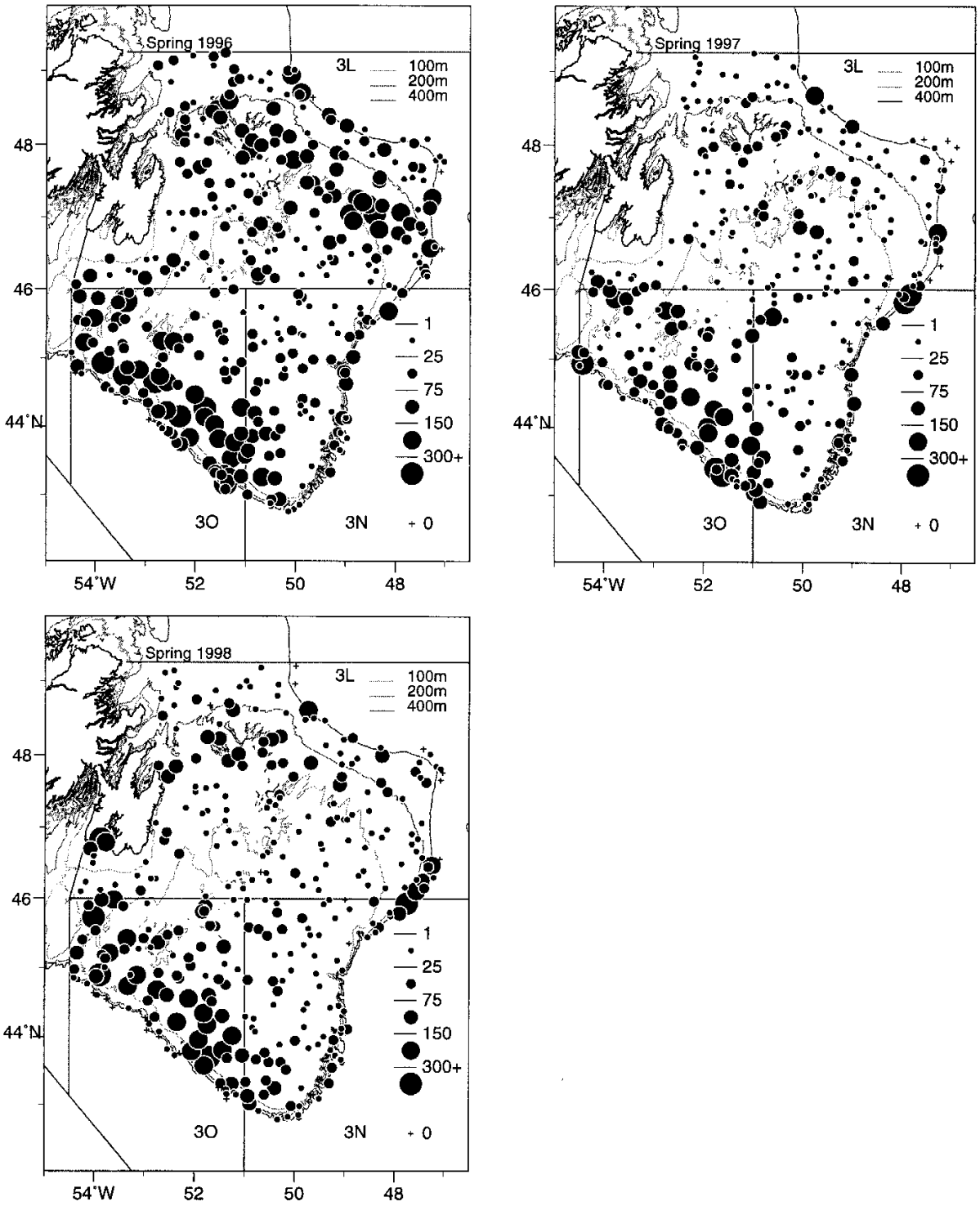


Fig. 7 Distribution of American plaice (numbers) from Canadian spring surveys in NAFO Divisions 3LNO from 1996-98.

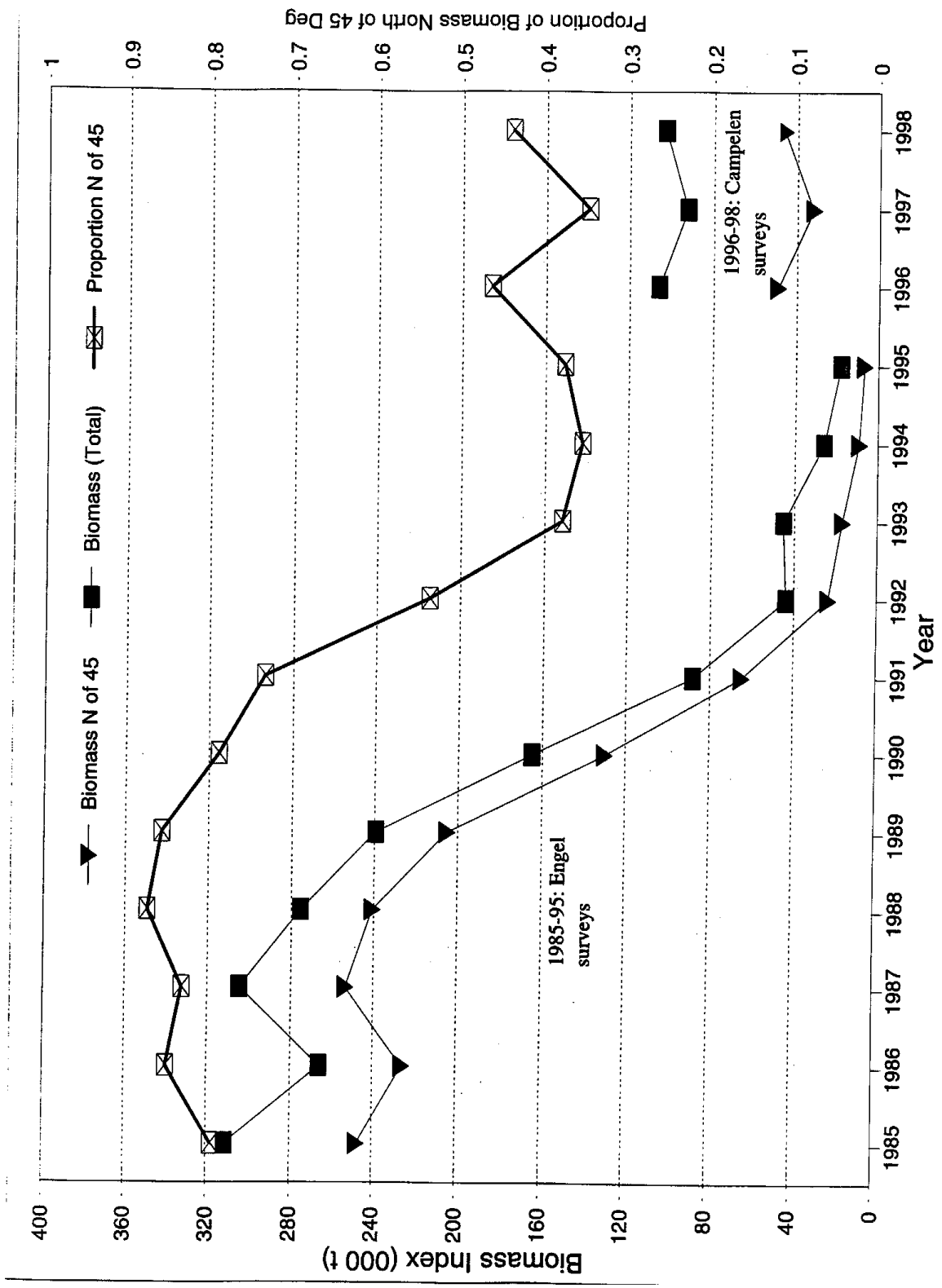


Fig. 8. Comparison of biomass estimates of A.plaice north of 45 degrees with total biomass estimates from spring surveys in Div. 3LNO.

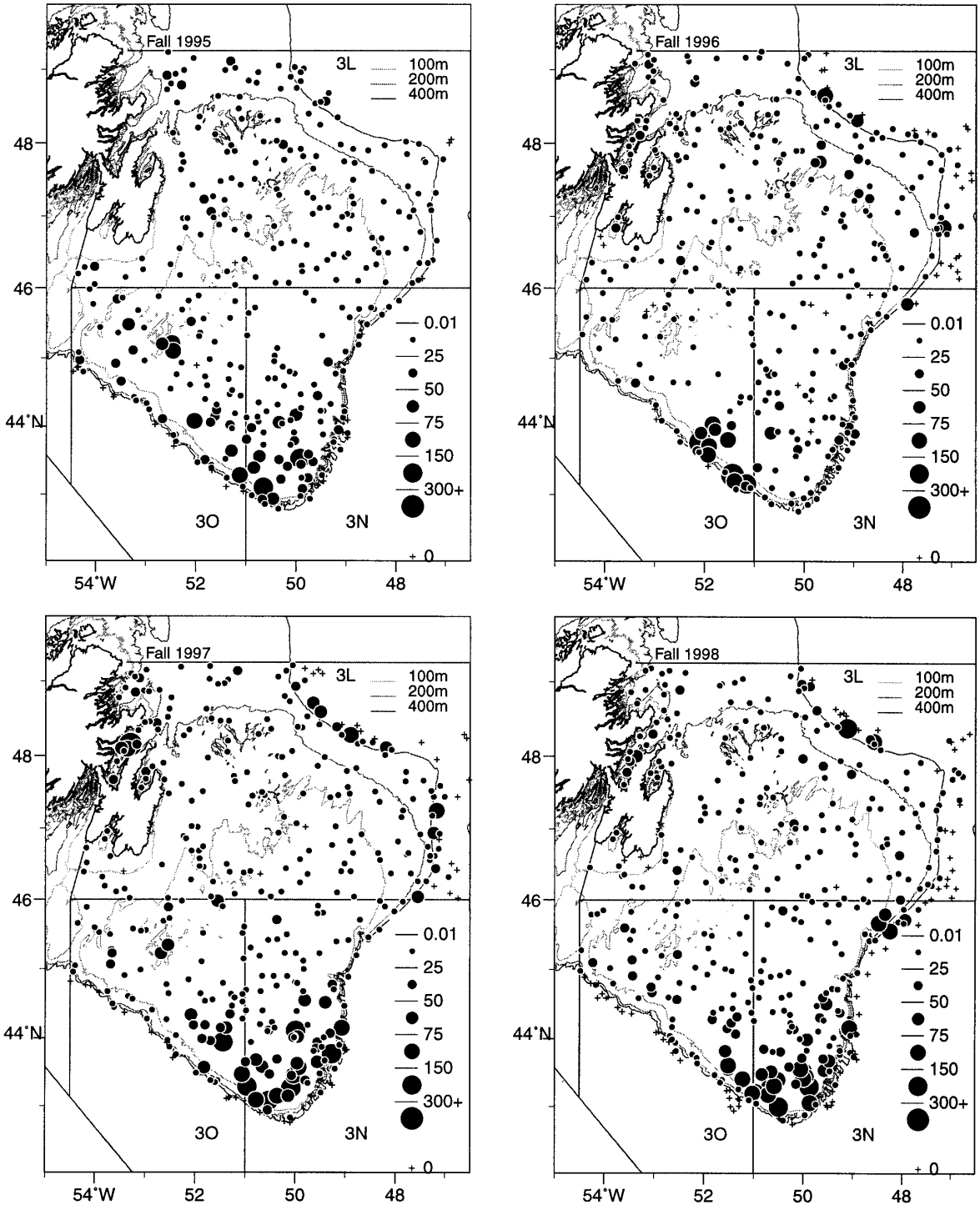


Fig. 9 Distribution of American plaice (Kg) from Canadian fall surveys in NAFO Divisions 3LNO from 1995-98.

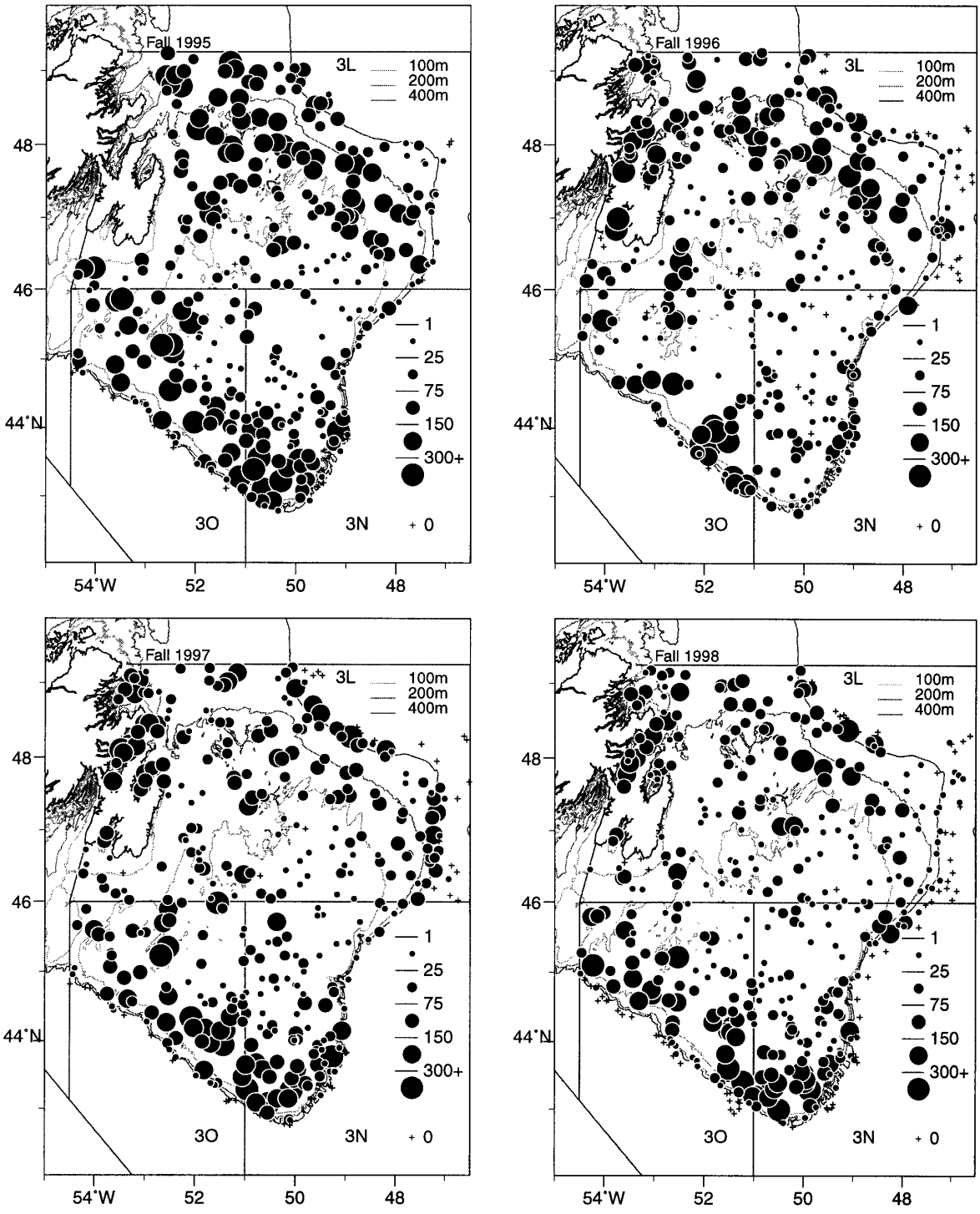


Fig. 10 Distribution of American plaice (numbers) from Canadian fall surveys in NAFO Divisions 3LNO from 1995-98.

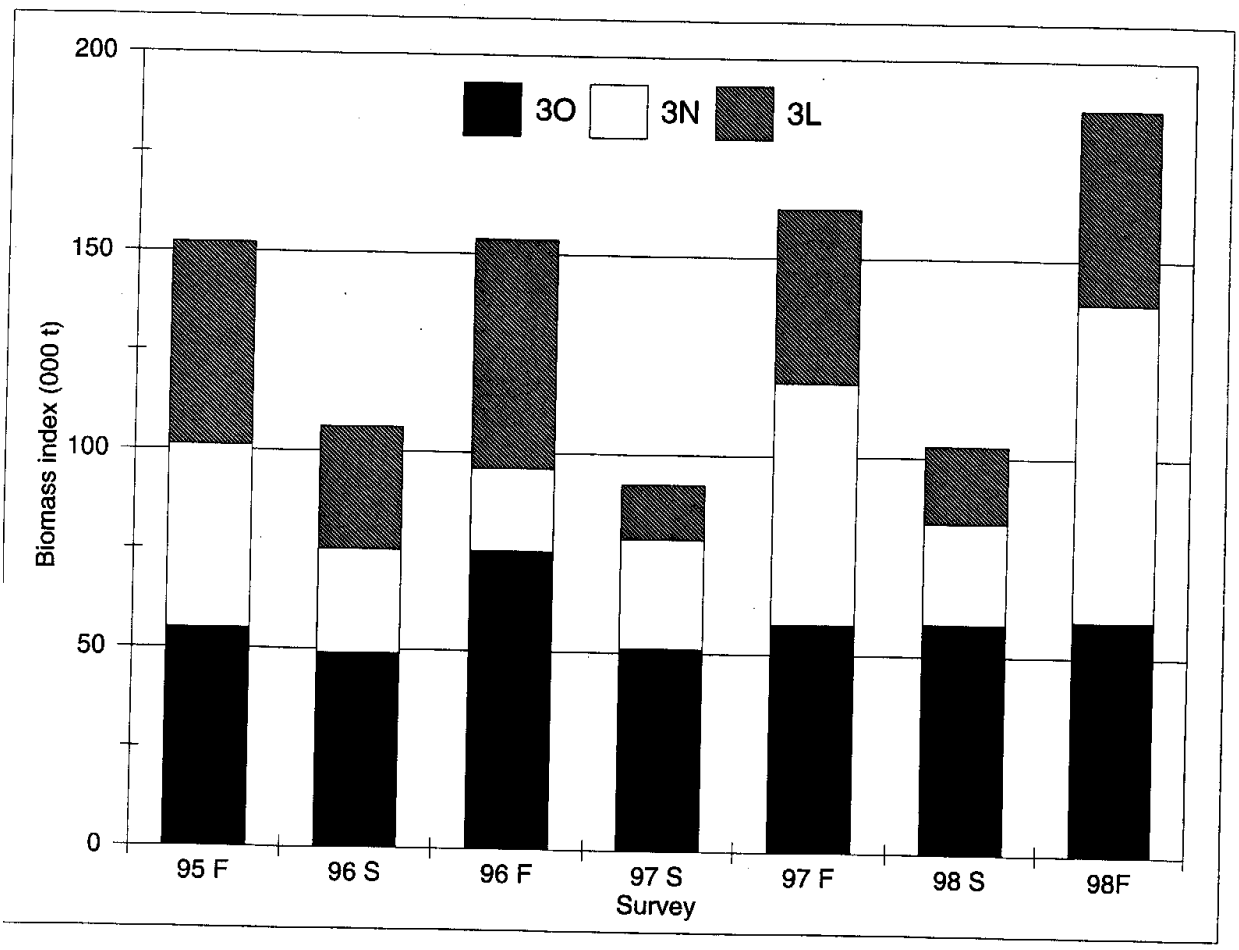


Figure 11. Comparison of spring and fall biomass estimates from Div. 3LNO from Campelen surveys only.

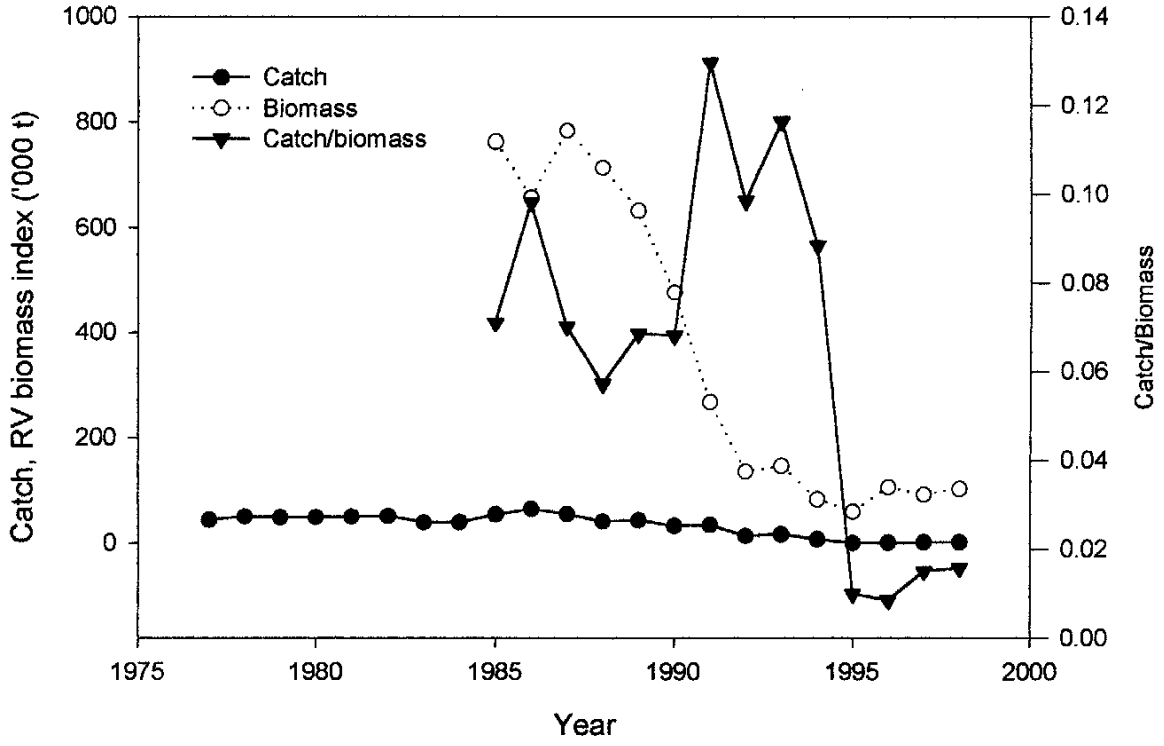


Figure 12. Total catch from 1977 to 1998 and RV biomass index from 1985 to 1998. Also shown is the catch/biomass ratio. Biomass is Campelen or equivalent.

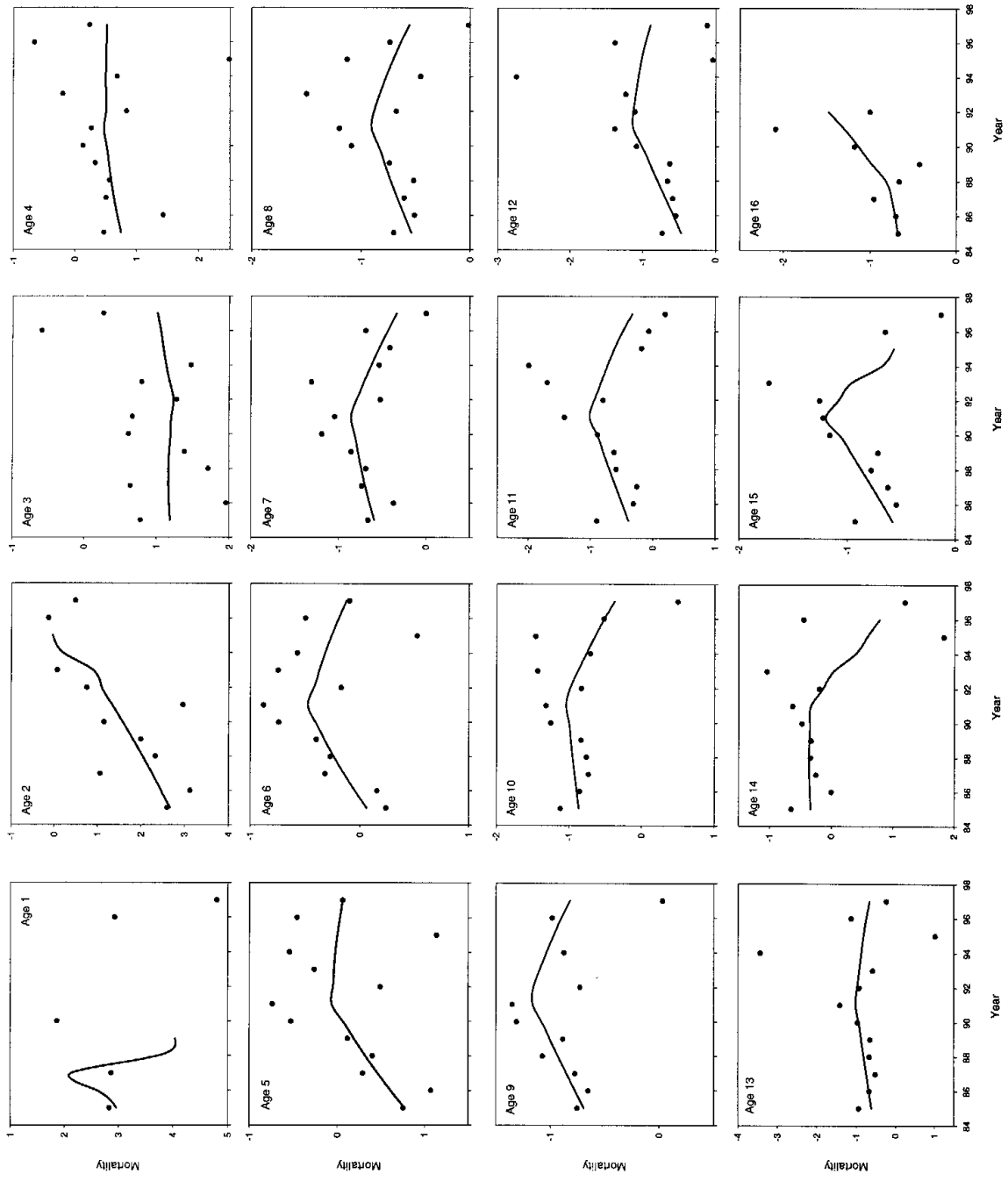


Figure 13. Estimates of mortality for ages 1 to 16 from Canadian spring surveys from 1985 to 1998.

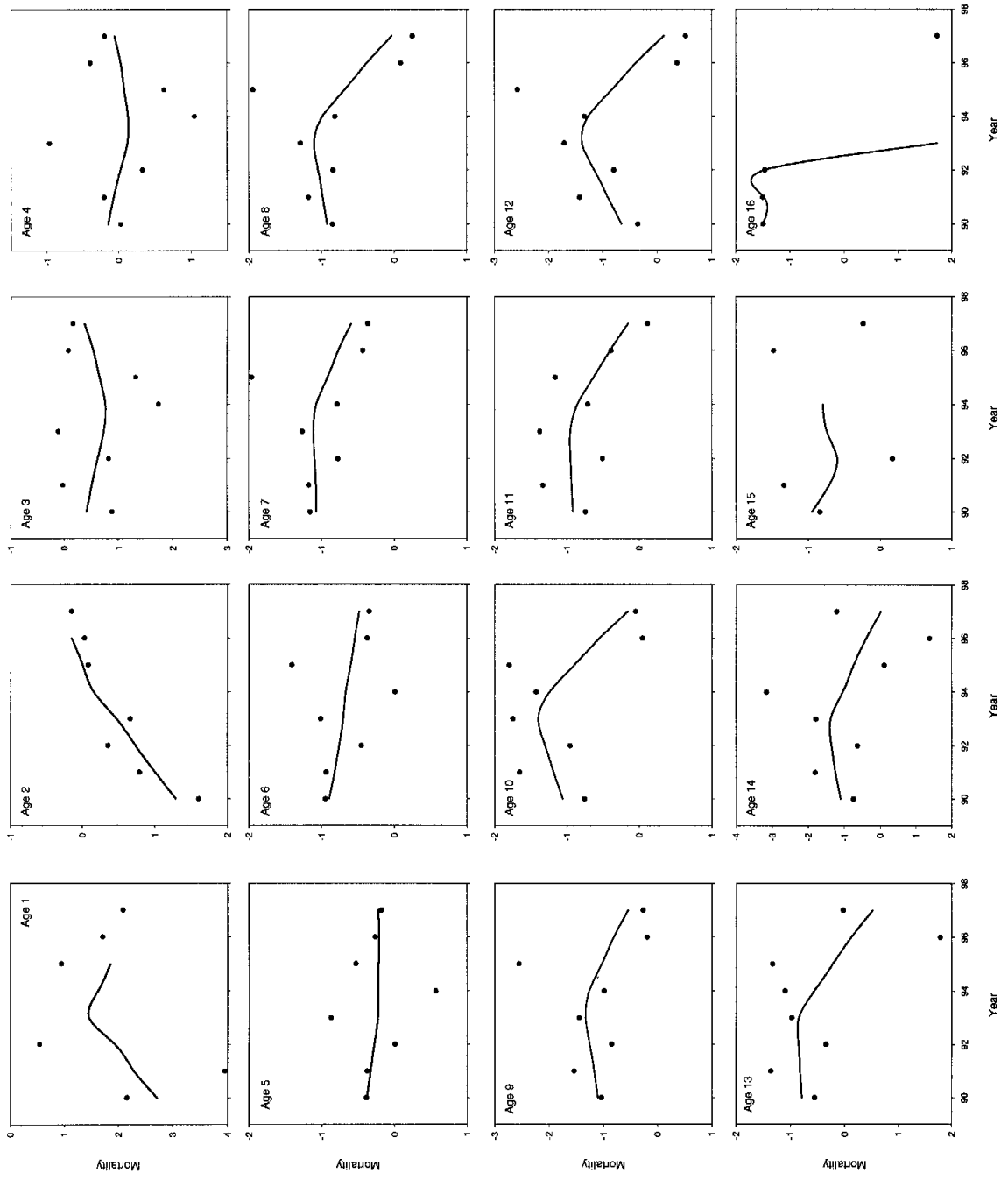


Figure 14. Estimates of mortality for ages 1 to 16 from Canadian fall surveys from 1990 to 1998.

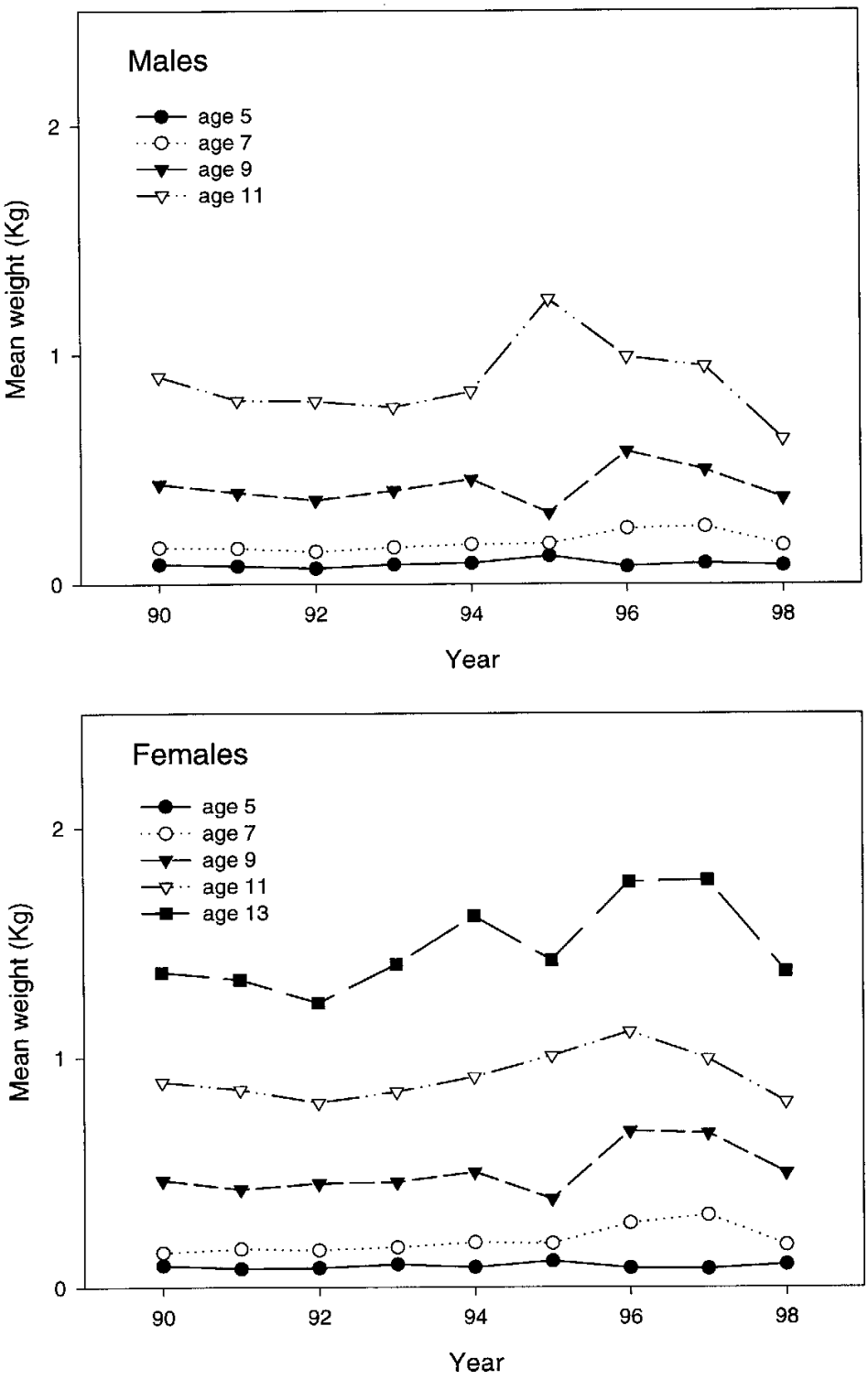


Figure 15. Mean weight at age for selected ages for male and female American plaice in Div. 3LNO.

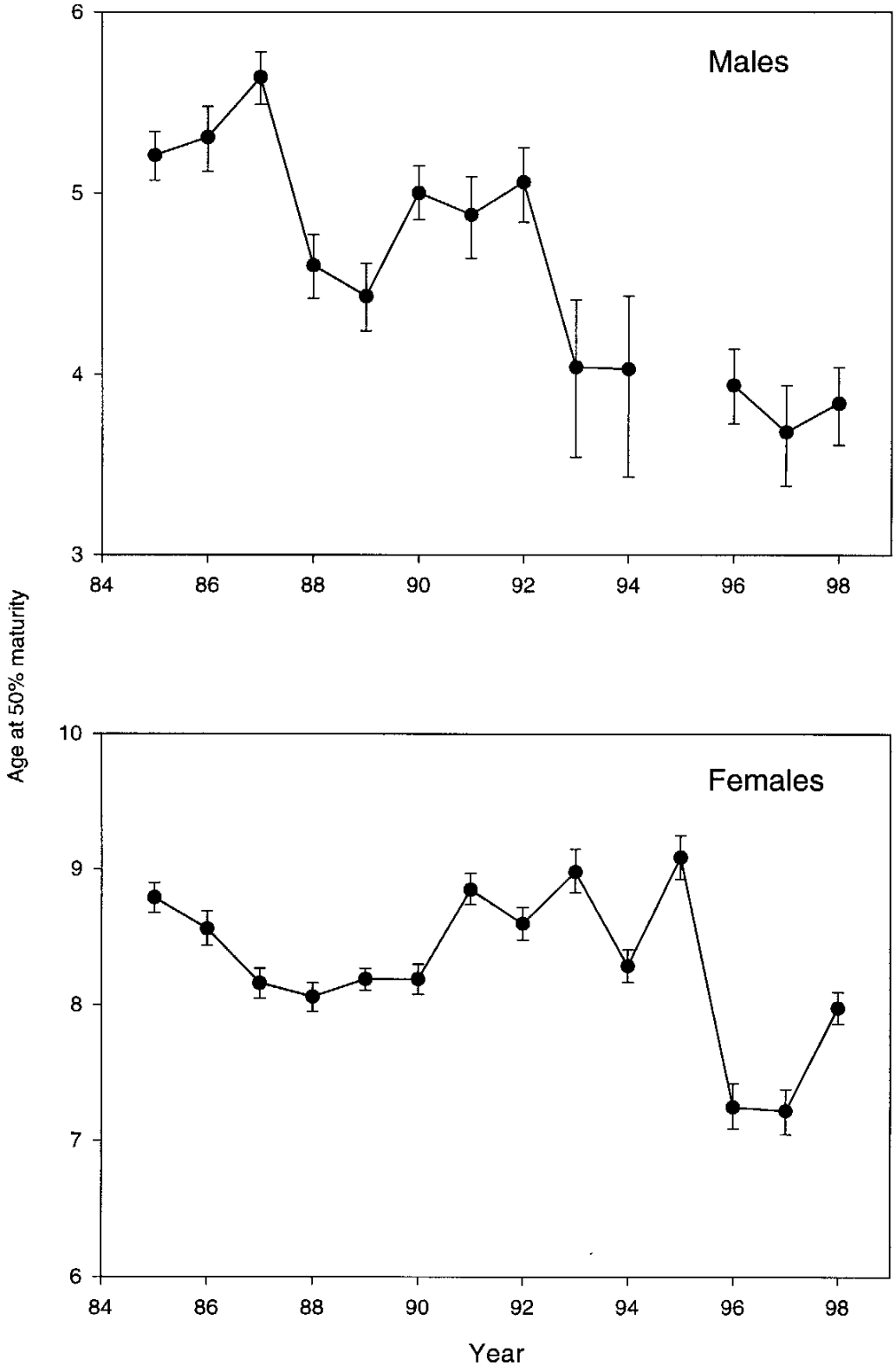


Figure 16. Age at 50% maturity for male and female American plaice in Div. 3LNO. Error bars are fiducial limits.

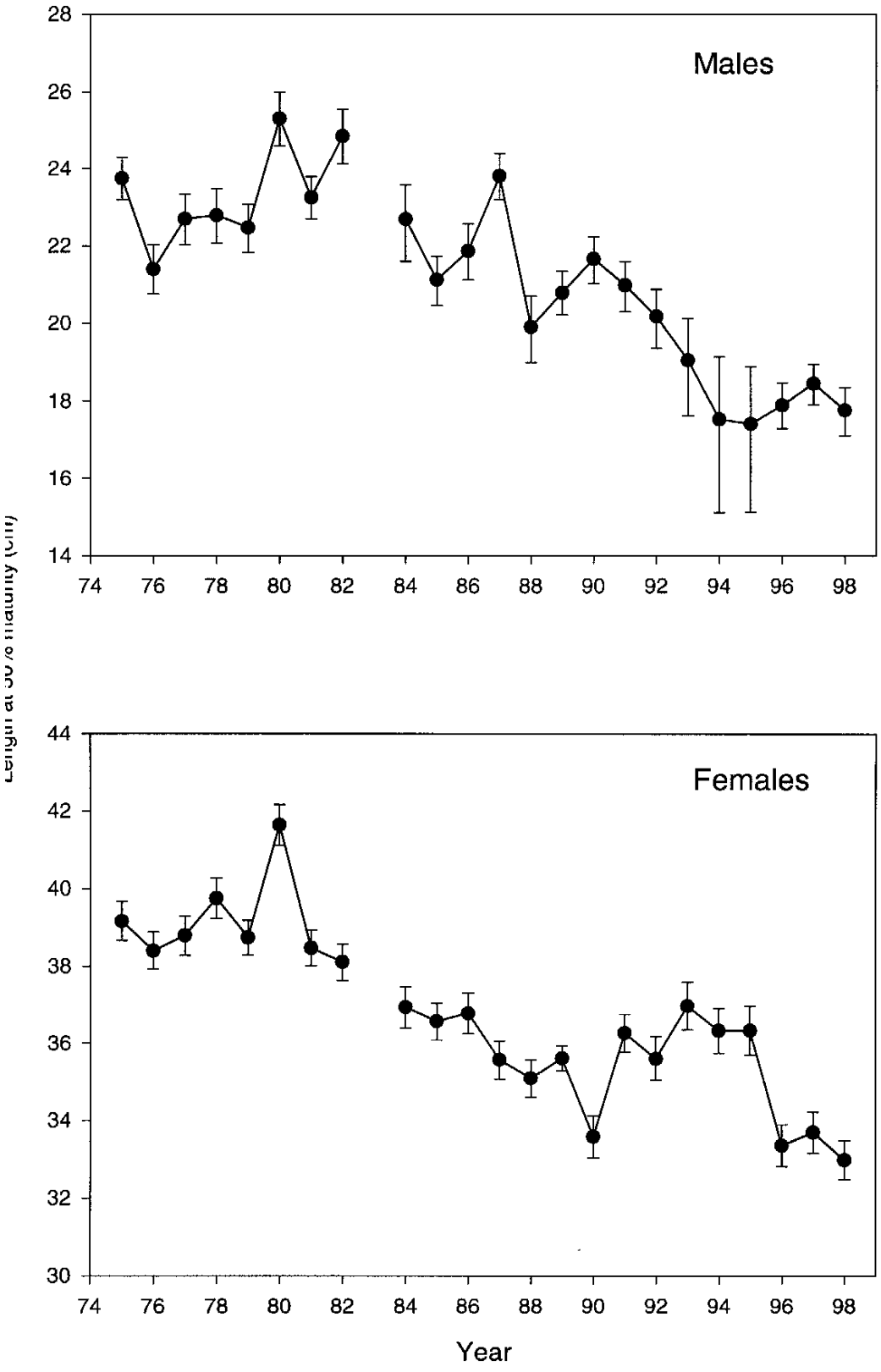


Figure 17. Length at 50% maturity for male and female American plaice in Div. 3LNO. Error bars are fiducial limits.

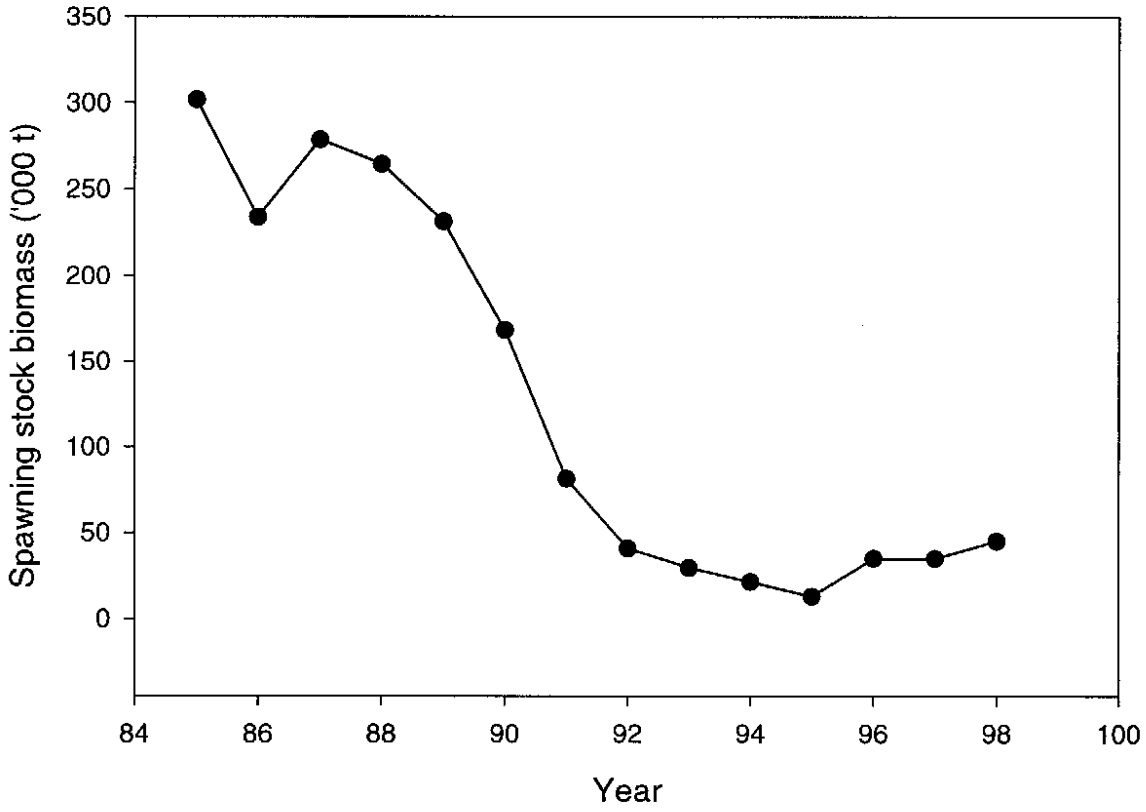


Figure 18. Female spawning stock biomass ('000 t) from Canadian spring RV surveys from 1985 to 1998.

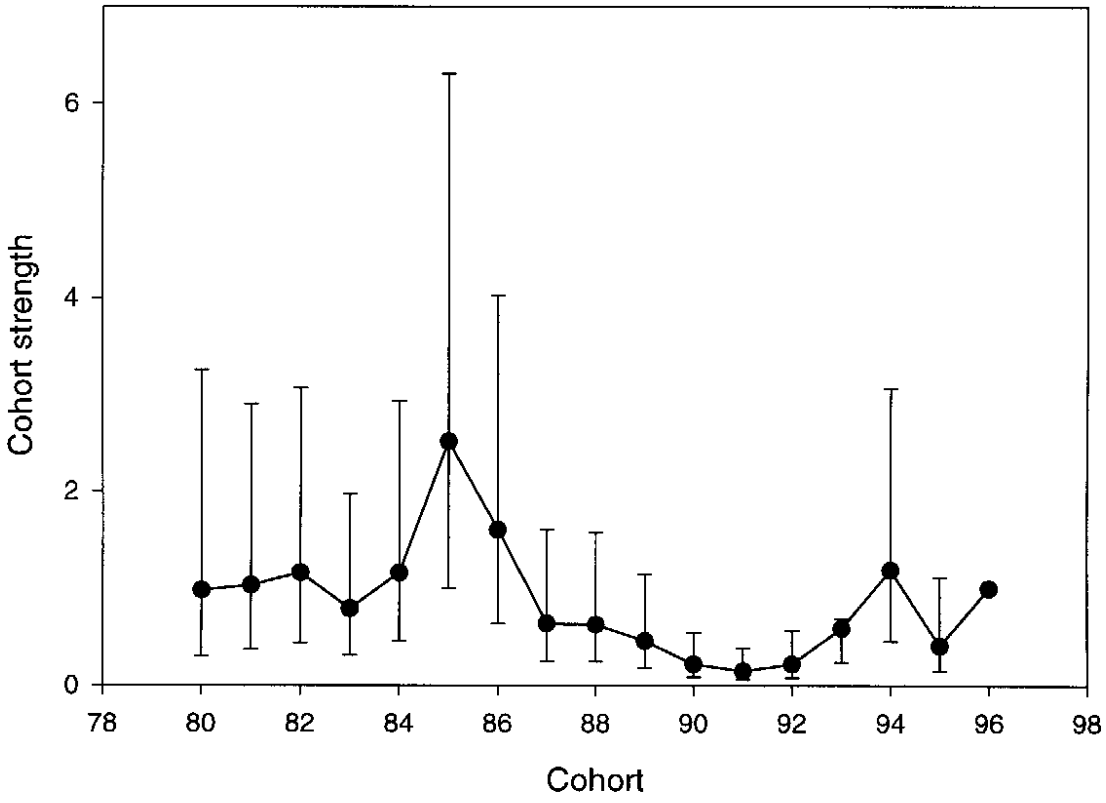


Figure 19. Cohort strength as estimated from a multiplicative model of data from Canadian spri
RV surveys from 1985 to 1998.

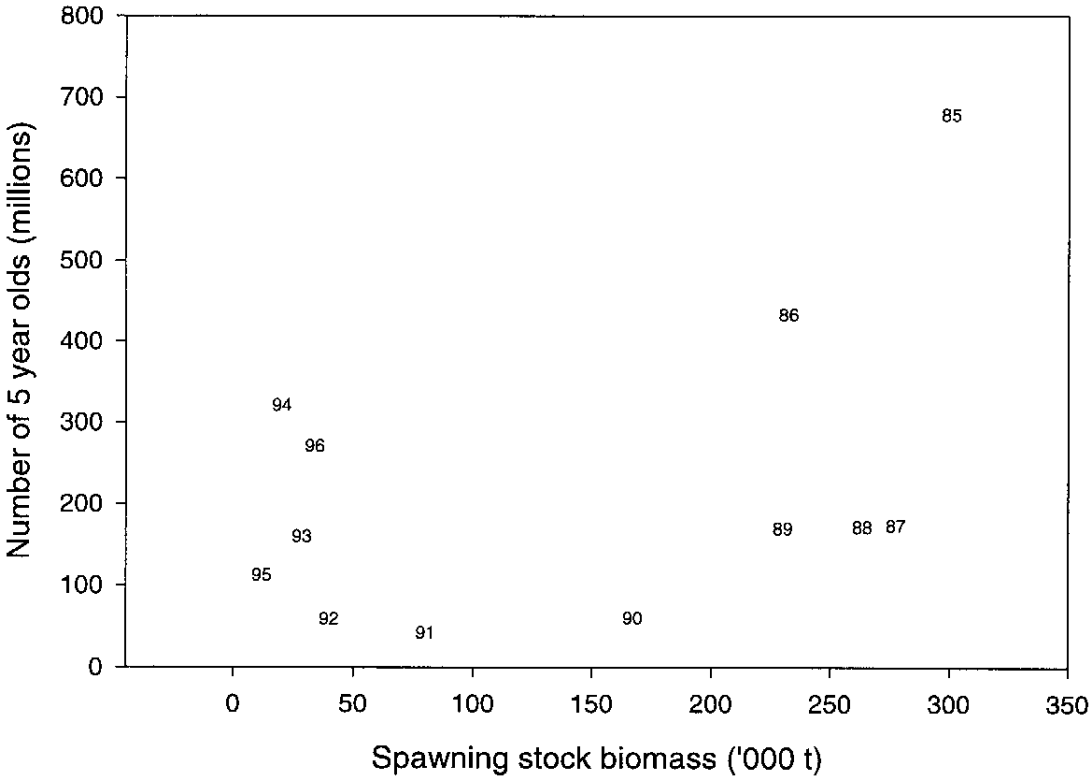


Figure 20. Female spawning stock biomass ('000 t) and recruitment at age 5 (millions) from the Canadian spring RV survey from 1985 to 1998 in Campelen or equivalent units. Recruitment was predicted from a multiplicative model of cohort strength.

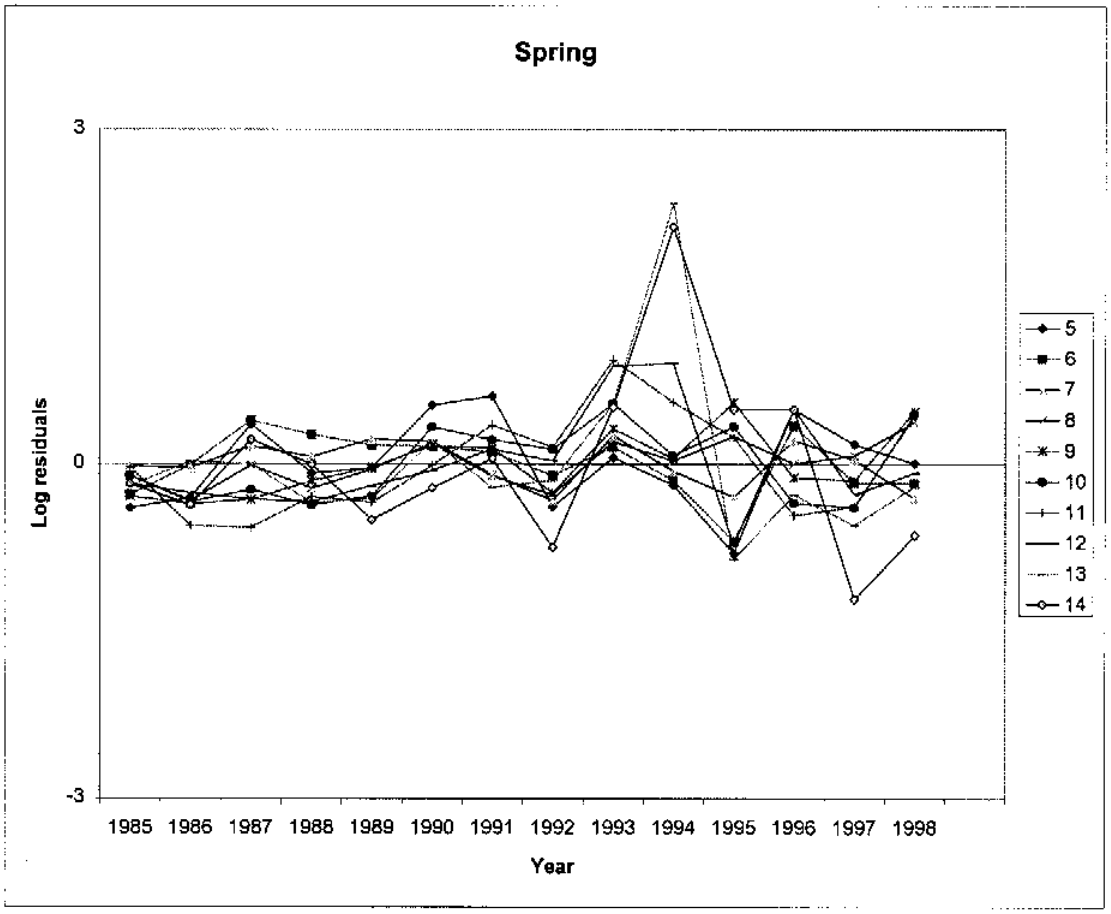


Fig. 21. Log residuals from ADAPT for spring Canadaian research vessel surveys.

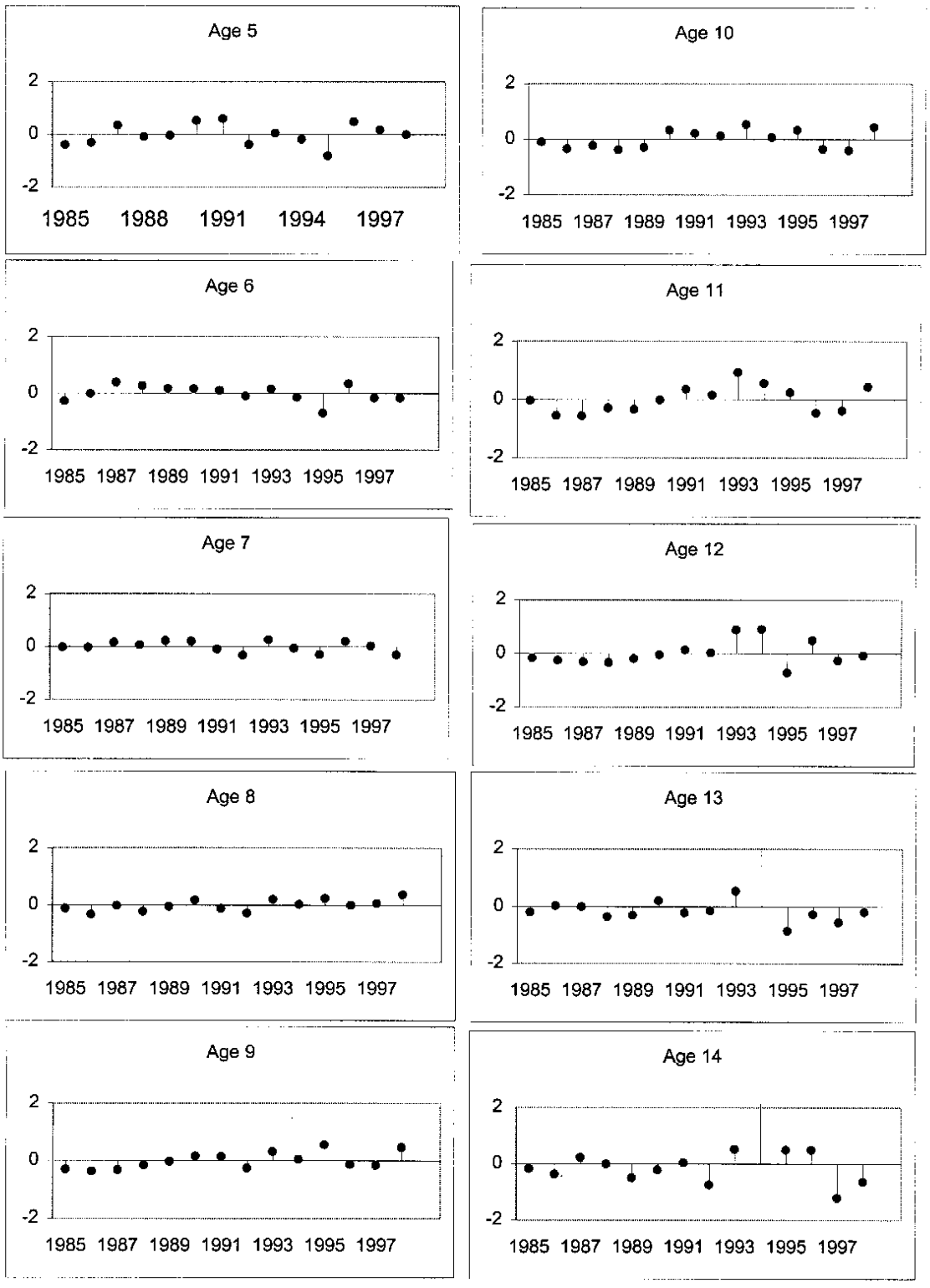


Figure 22. Age by age log residuals from Canadian spring surveys .

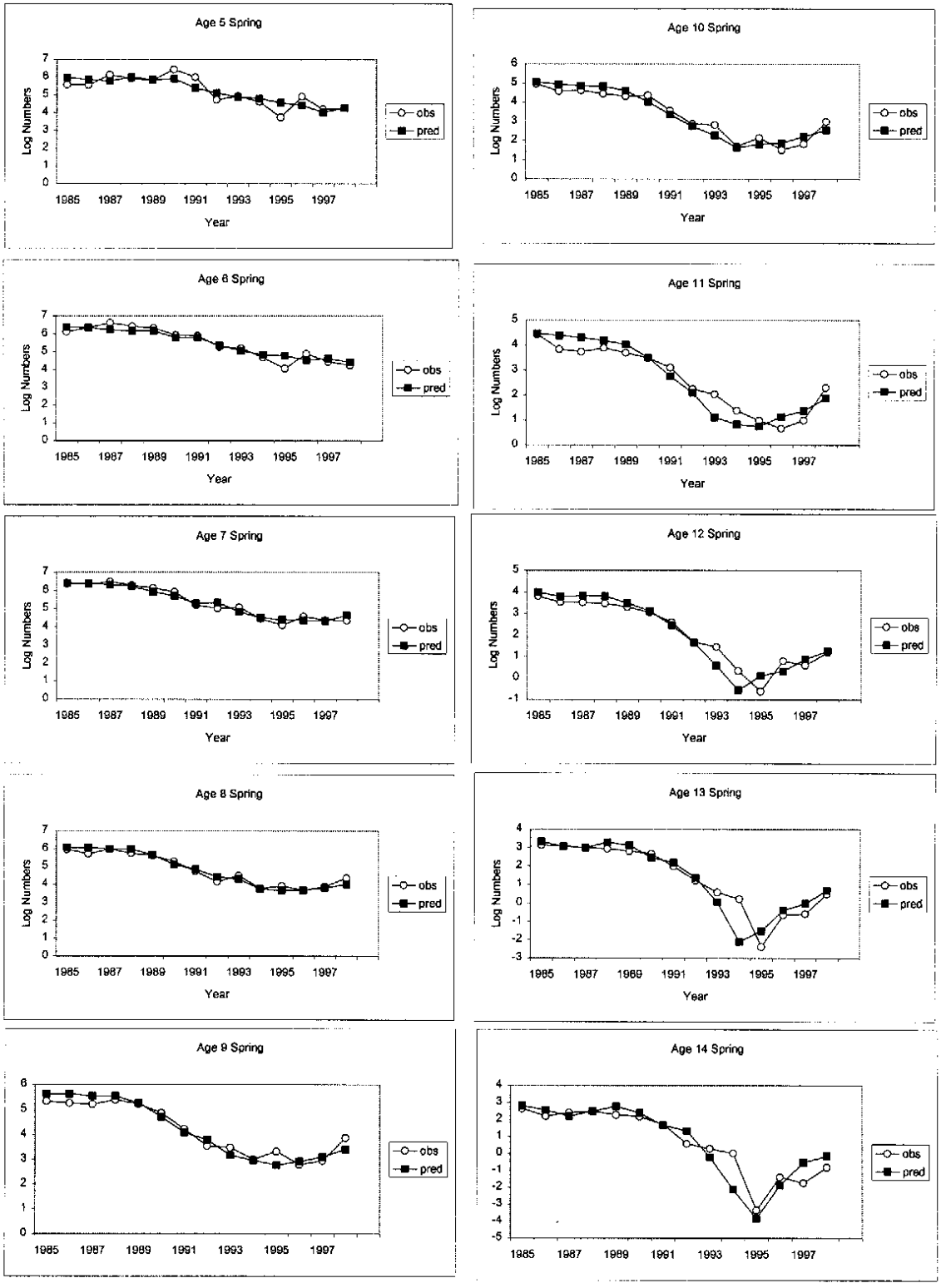


Figure 23 Age by age observed and predicted log abundance index over time from Canadian spring surveys for Am. plaice in NAFO Divisions 3LNO.

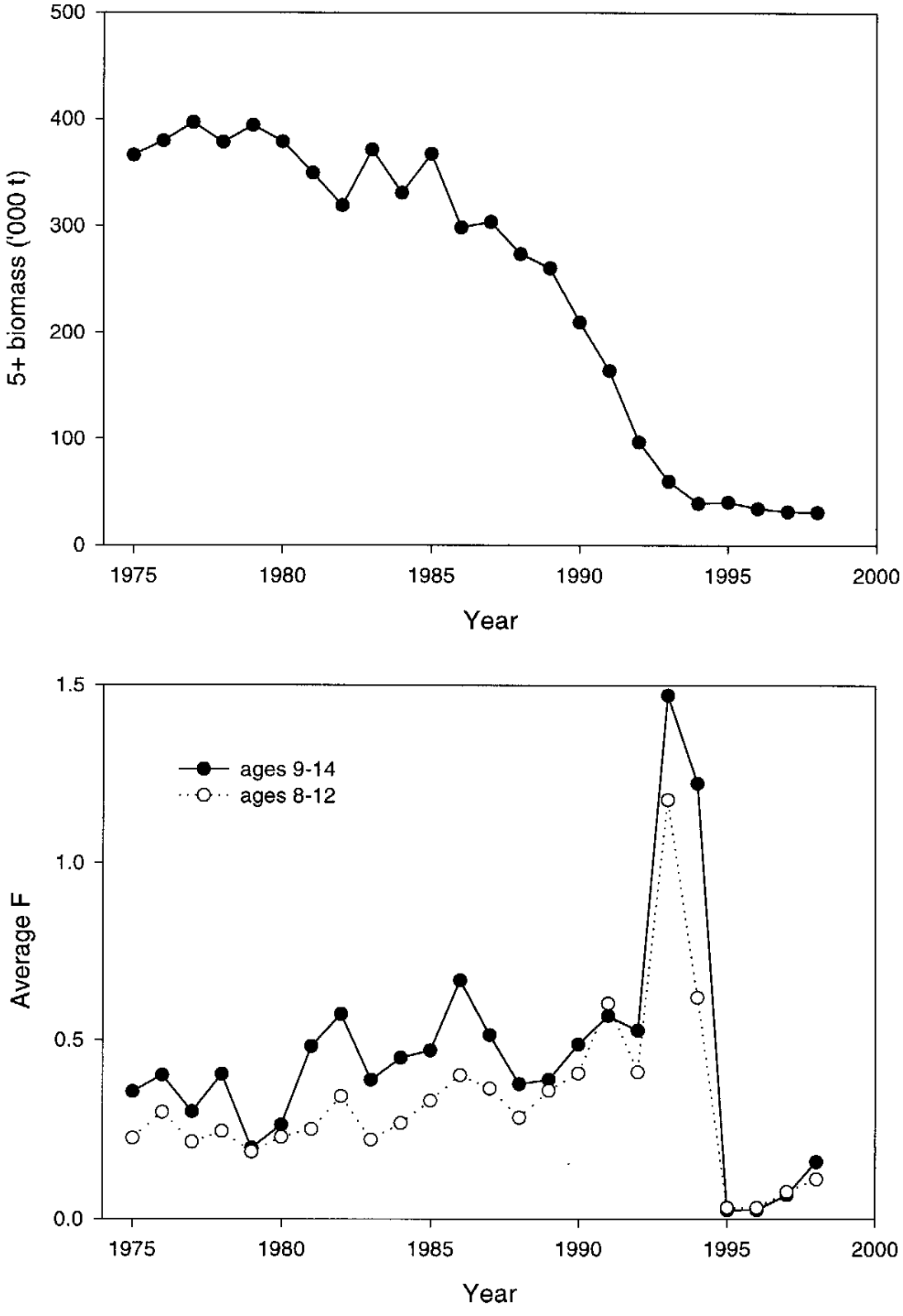


Figure 24. 5+ biomass (top) and average fishing mortality on ages 9 to 14 and ages 8 to 12 (bottom) from VPA.

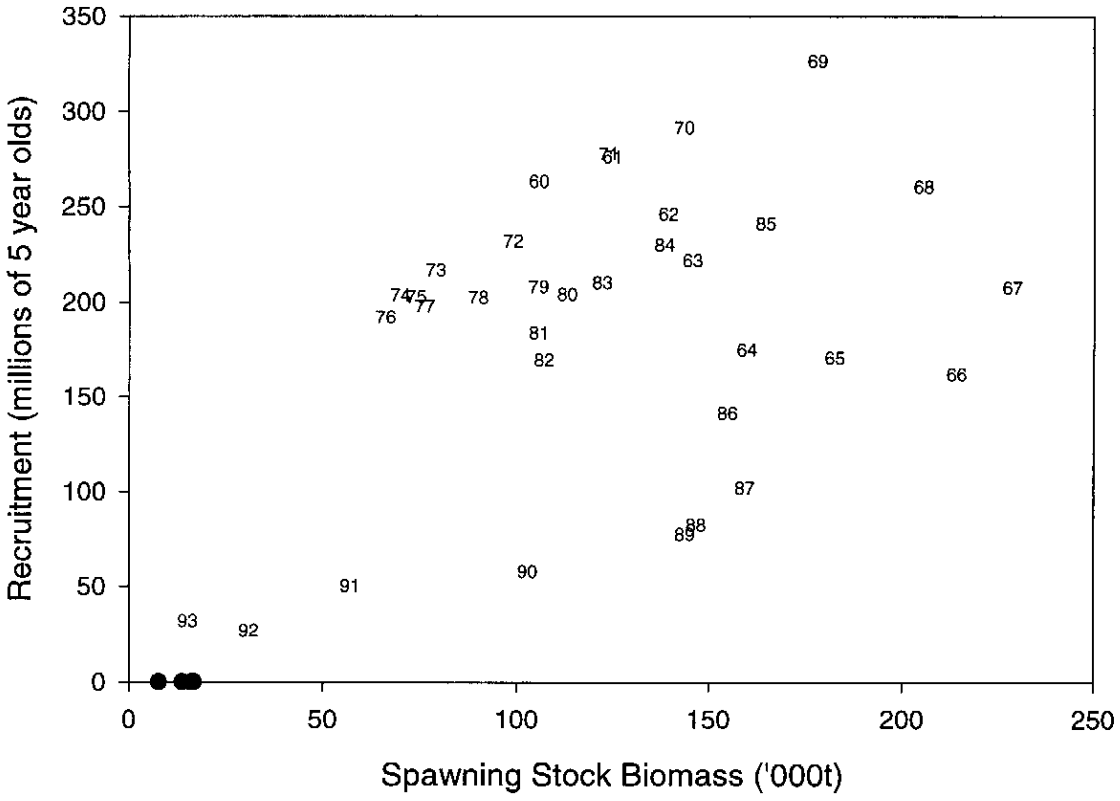


Figure 25. Spawning stock biomass and recruitment as estimated from VPA.
The numbers indicate the year class. The dots on the x axis indicate the SSB from 1994 to 1998.