



## STOCK ASSESSMENT ON SUBDIVISION 3Ps AMERICAN PLAICE

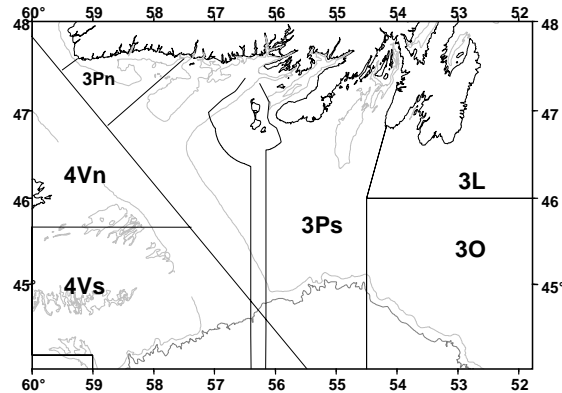
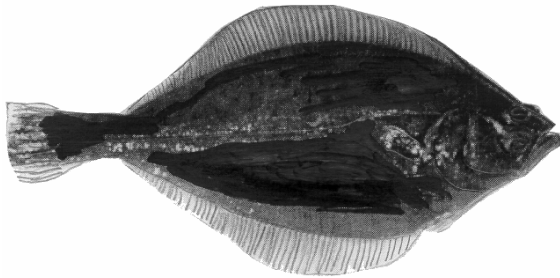


Figure 1: Map of the stock area of Subdivision 3Ps American plaice.

### Context

American plaice, which occurs on both sides of the North Atlantic, is a bottom dwelling flatfish. In the western Atlantic, the species ranges from USA waters to the Arctic, with the largest population occurring on the Grand Bank off Newfoundland. American plaice are found over a wide range of depths and temperatures.

Female American plaice in 3Ps mature at about age 9 and 36 cm while male plaice mature at about age 4 and 16 cm. This is a relatively slow growing species with fish not reaching 40 cm until nearly age 10.

Catches from this stock were highest from 1968 to 1973, during which time they averaged over 10 000 t. Since 1980, catches have exceeded 5000 t only twice. Through the 1980's the majority of this fishery occurred in the offshore. Both offshore and inshore catch declined substantially in the early 1990's and since 1995 the offshore catch has constituted less than 50% of the total. The stock has been under moratorium since September 1993.

### SUMMARY

- This stock has been under moratorium since September of 1993.
- Since 1992 stock size as measured by the DFO RV survey has been very low compared to the beginning of the time series.
- There has been a slight increase since 1993 in both biomass and abundance indices in the DFO RV survey but current biomass is only 20% and abundance 26% of the 1983-87 average.

- The indices from the survey conducted by GEAC increased from their start in 1998 to 2001 but have been lower since.
- Current female SSB calculated from the DFO RV survey index is only 25% of the 1983-87 average.
- Estimates of recruitment from DFO RV survey data indicated that cohort strength declined from the 1979 to the 1995 year class. Cohort strength then increased to 1998 and then declined to 2002. The 2002 cohort (the most recent estimate) is the third lowest in the time series.
- There is a fairly clear stock-recruit relationship. The current SSB index is at a level that suggests that recruitment will be less than half of its maximum potential.
- Catch to survey biomass ratios indicate that exploitation rate has been increasing since the mid 1990's. Levels of the last few years are similar to those in the early to mid 1980's when there was a directed fishery on this stock.
- Catches at recent levels are contributing to the lack of recovery.

## DESCRIPTION OF THE ISSUE

### Fishery

Catches from this stock were highest from 1968 to 1973, exceeding 12,000 t in three years (Fig. 2). Catches by non-Canadian vessels peaked at about 8800 t in 1968, due mainly to the USSR catch, and have not exceeded 800 t since 1973. Since 1977 only Canada and France have been involved in this fishery. Catches averaged just under 4000 t during the 1980's but rapidly declined after 1991. Based on a recommendation by the Fisheries Resource Conservation Council (FRCC) the fishery has remained closed since September of 1993. From 1994 to 1998 the catch was 400 t or less. Catch since that time has increased substantially. During 2001 to 2003 the catch was greater than 1000 t in each year. In 2004 the catch declined somewhat to just over 800 t. Catch to September 2005 is 500 t. Catch has been mainly as bycatch in the cod and witch flounder directed fisheries.

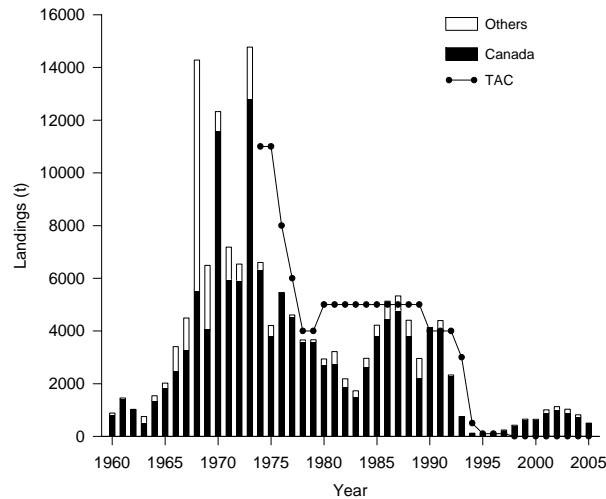


Figure 2. Total catch by Canada (black bars) and other countries (white bars) as well as total allowable catch (TAC) for each year from 1960 to 2005. Catch data for 2005 are incomplete.

## ASSESSMENT

### Key Indicators

Based on DFO research vessel (RV) surveys, both biomass and abundance showed a major decline from the mid 1980's to 1990's. Since 1992 stock size has been very low in comparison to the mid 1980's. There has been a slight increase since 1993 in both biomass and abundance indices, but over the last 3 years average biomass is only 20% and abundance 26% of the 1983-1987 averages from the survey (Fig. 3).

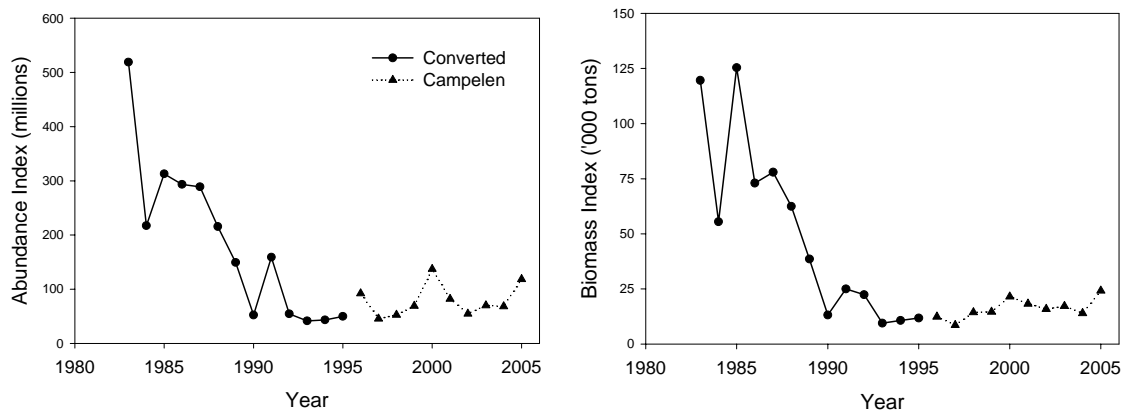


Figure 3. DFO research vessel survey indices of abundance and biomass from 1983 to 2005. Converted (1983-1995) and Campelen (1996-2005) data are shown.

For the 7+ or exploitable portion of the survey index, the biomass is 17% and the abundance 12% of the 1983-87 average (Fig. 4). Since 1998 information is available from a survey sponsored by the Groundfish Enterprise Allocation Council (GEAC) and this also provides an index of the exploitable portion of the stock. The indices from this survey increased to 2001 and have been lower since. The 1998 survey estimate is likely to have been anomalous (Fig. 4).

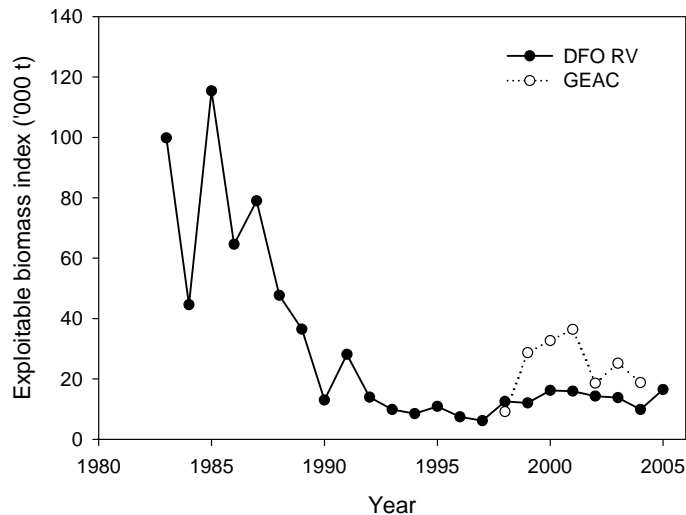


Figure 4. Exploitable biomass index of American plaice from DFO research vessel surveys from 1983-2005, as well as an industry sponsored survey (GEAC) from 1998-2004. Data from 1983-95 in the DFO time series are converted from the Engel data.

Age structure in the DFO RV survey was relatively stable until 1994 when fish older than 14 years disappeared from the survey. By 1998, older fish began to reappear in the surveys and by 2002 the age structure was more similar to the historic pattern. The oldest age in the survey was 17 or greater in each of the last 6 years, however the percentage of fish in the 9+ category was below average in 2004 and 2005.

### Stock Trends and Current Status

A female spawning stock biomass (SSB) index was calculated from DFO RV survey information (Fig. 5). The SSB index showed a major decline from the mid 1980's to the early 1990's and has shown a slight increase since 1997. The SSB index from 2003-2005 is 25% of the 1983-1987 average.

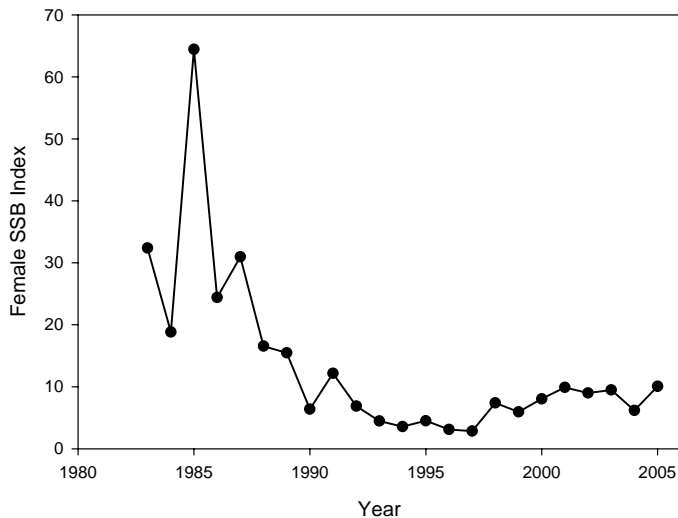


Figure 5. Female spawning stock biomass index of American plaice from DFO research vessel surveys. The Campelen data from 1983-95 are converted from the Engel series.

Estimates of recruitment from DFO RV survey data indicated that cohort strength declined from the 1979 to the 1995 year class. Cohort strength then increased to 1998 and then declined to 2002. The 2002 cohort (the most recent estimate) is the third lowest in the time series (Fig. 6).

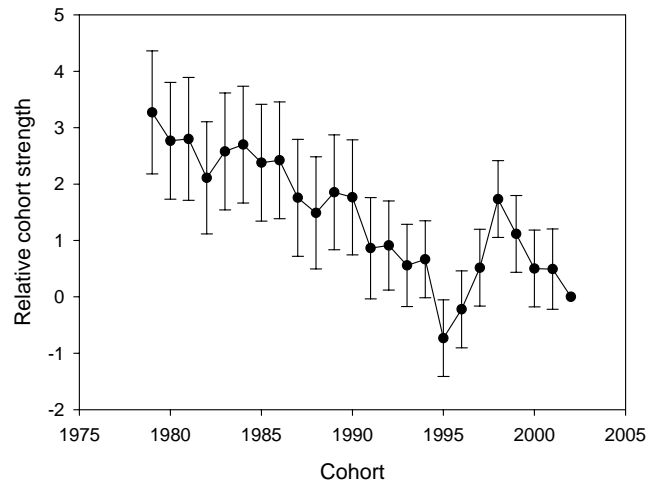


Figure 6. Estimates of relative recruitment (cohort strength) of American plaice from DFO research vessel surveys using Engel and Campelen data. Estimates are relative to the last cohort in the analysis. Error bars are  $\pm 1$  Std. err. of the model estimate of cohort strength.

Although there is variability at low stock size, there is a fairly clear stock recruit relationship. Change point regression analysis estimates that an SSB index of about 13.6 gives a recruitment that is 50% of the maximum estimated. Currently the SSB index is 10 (average of 8.6 over last 3 years) and has been below 13.6 since the early 1990's (Fig. 7). This level suggests that recruitment will be less than half of its maximum potential.

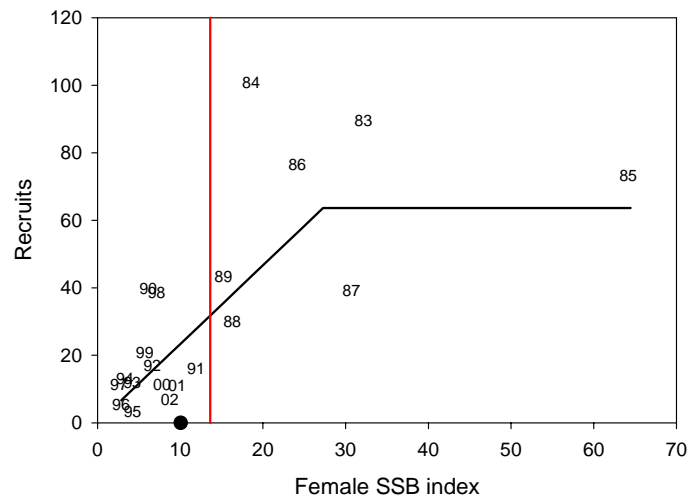


Figure 7. Estimated number of recruits and female SSB index from DFO research vessel surveys. The symbols indicate the year class. The dot indicates the level of SSB in 2005. The fitted change point regression line is shown. The vertical line shows the SSB index giving 50% of the maximum level of recruitment.

Growth as measured by mean length at age in DFO research vessel surveys from 1983-2005 has shown some increase over the time period, especially for females (Fig. 8). Mean weight at age has shown little trend over the 1990-2005 time period.

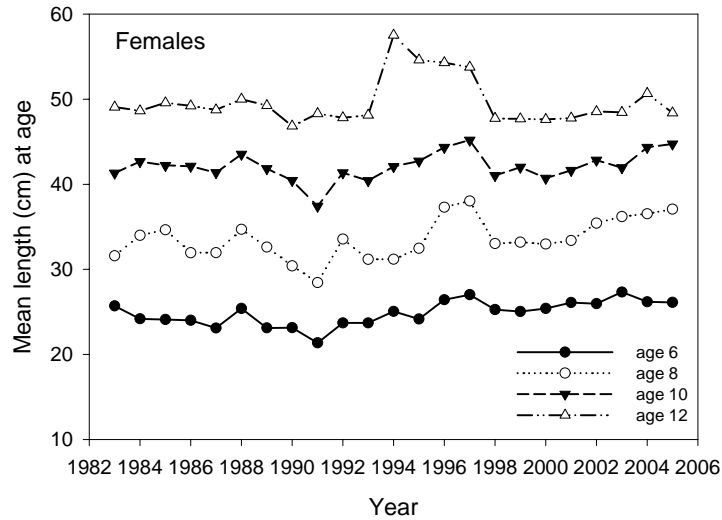


Figure 8. Mean length at age of female American plaice from research vessel surveys from 1983 to 2005.

Males mature at a substantially younger age than females and at a smaller size. Age at maturity for both males and females declined significantly since the beginning of the time series (Fig. 9). Currently the age at 50% maturity for females is 8 years compared to 11 at the beginning of the time series and 4 for males compared to 7. Length at maturity has also shown a decline since the start of the time series. Male length at 50% maturity has declined from 27 cm to 18 cm while for females it has declined from 40 cm to 36 cm.

For this species decreased age and size at maturity have been found to be related to decreased population size, increased temperature and increased growth, as well as increased mortality.

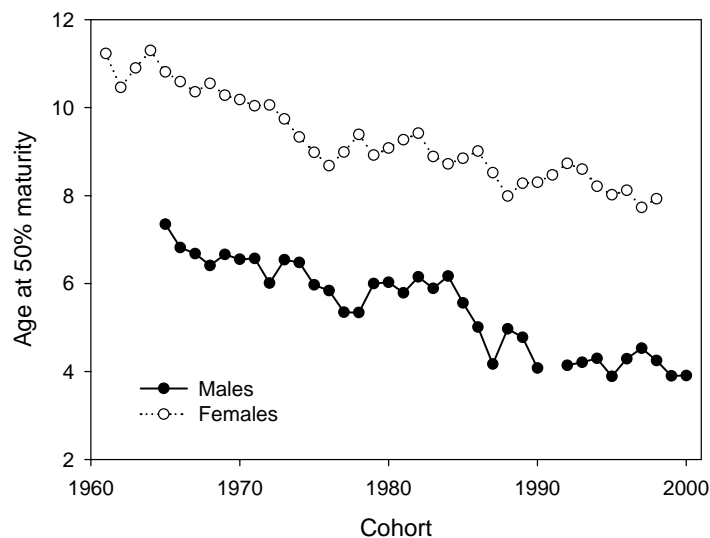


Figure 9. Age at 50% maturity for male and female American plaice.

Estimates of total mortality from DFO RV survey data increased from the mid 1980's to the early to mid 1990's. Total mortality remained high in 1994 and 1995 following the imposition of the

moratorium despite low catches. This may indicate an increase in natural mortality over that time period. Estimates of total mortality have been lower since then (Fig. 10).

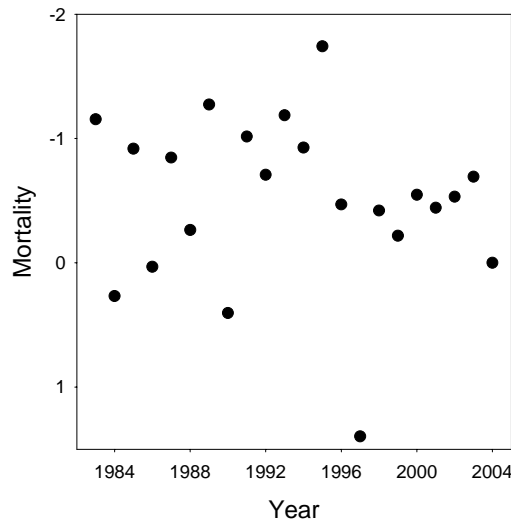


Figure 10. Estimates of total mortality for age 11 American plaice from DFO research vessel surveys in Subdivision 3Ps from 1983 to 2005.

Catch to DFO RV survey biomass ratios (C/B), used as an index of exploitation rate, increased steadily through the 1980's and reached values of approximately 0.15 during the early 1990's. (The high value in 1990 was caused by an anomalously low RV biomass estimate in that year). The ratio declined substantially as catches decreased, and reached a minimum in 1995. Since then there has been a fairly steady increase in C/B. Levels of the last few years are similar to those in the early to mid 1980's when there was a directed fishery on this stock (Fig. 11).

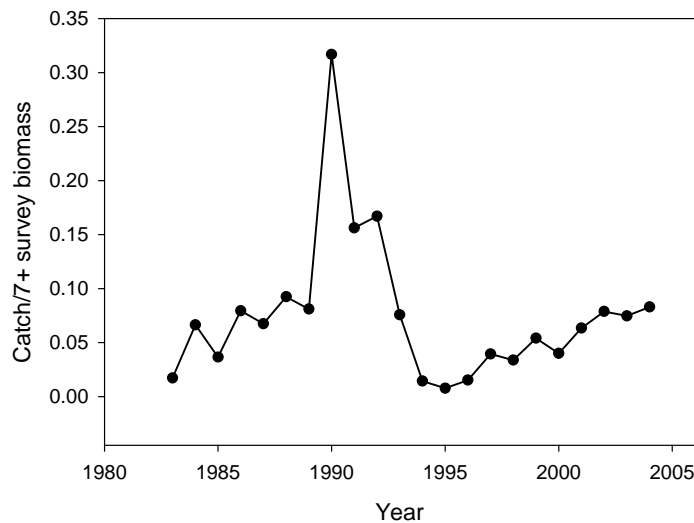


Figure 11. Commercial catch to research vessel biomass ratio. Research vessel data are from DFO RV surveys from 1983 to 2004. The survey data are only for the exploitable portion of the biomass.

### Sources of Uncertainty

This assessment is based solely on analyses of survey indices and trends in catch. There has been insufficient sampling of the commercial catch during much of the 1990's to calculate catch

at age. In addition commercial sampling in recent years has not been representative of the entire bycatch, with little or no sampling of fixed gear catches. This means that it has not been possible to explore the use of age structured models to estimate total population size.

## ADDITIONAL STAKEHOLDER PERSPECTIVES

Bycatch in the witch flounder otter trawl fishery decreased after bycatch restrictions were added to the Conservation Harvesting Plan. There is some indication of an increase in abundance of American plaice in the area from 2000 to 2005.

Fixed gear fisheries also take American plaice as a bycatch. There has been insufficient sampling of the American plaice bycatch in these fixed gear fisheries. An important source of information about such things as age structure is thereby being lost. Inshore fish harvesters feel that there is a fair amount of plaice throughout the 3Ps area.

## CONCLUSIONS AND ADVICE

Indices of abundance and biomass showed a large decline from the mid 1980's to mid 1990's. Since 1992 stock size has been very low. There has been a slight increase over the 1992-2005 time period in both biomass and abundance indices but average biomass over the last 3 years is only 20% and abundance 26% of the 1983-87 average. Year class strength has declined since 1998 and the 2002 year class is the third lowest in the time series. Catch increased substantially since 1995, and was over 1000 t in each year from 2001 to 2003. Catch to survey biomass ratios indicate that exploitation rate has been increasing since the mid 1990's. Catch to survey biomass ratios have continued to increase although catch declined somewhat in 2003 and 2004. This is the result of a somewhat lower exploitable biomass. The 1998 and 1999 year classes are near average and may result in some increase in the exploitable biomass over the short term. However they are followed by several below average year classes. There is a fairly clear stock-recruit relationship. The current SSB index is at a level that suggests that recruitment will be less than half of its maximum potential. Catches at recent levels are contributing to the lack of recovery.

## SOURCES OF INFORMATION

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**FOR MORE INFORMATION**

Contact: Joanne Morgan  
Northwest Atlantic Fisheries Centre  
PO Box 5667  
St. John's, NL  
A1C 5X1  
Tel: (709) 772-2261  
Fax: (709) 772-4105  
E-Mail: [morganj@dfo-mpo.gc.ca](mailto:morganj@dfo-mpo.gc.ca)

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Regional RAP Office  
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Fisheries and Oceans Canada  
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Telephone: (709) 772-2302/8892  
Fax: (709) 772-6100  
E-Mail: [richardsed@dfo-mpo.gc.ca](mailto:richardsed@dfo-mpo.gc.ca)  
Internet address: [www.dfo-mpo.gc.ca/csas](http://www.dfo-mpo.gc.ca/csas)

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