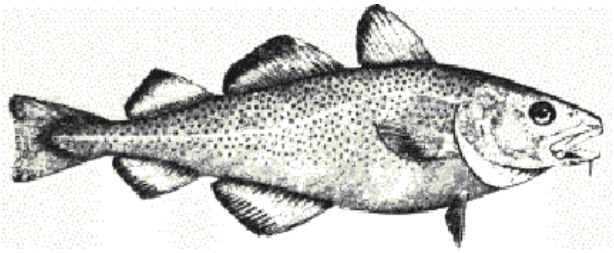
Fisheries and Oceans Canada | Pêches et Océans Canada
Science | Sciences
Newfoundland and Labrador Region
Canadian Science Advisory Secretariat
Science Advisory Report 2006/040

STOCK ASSESSMENT ON SUBDIVISION 3Ps COD



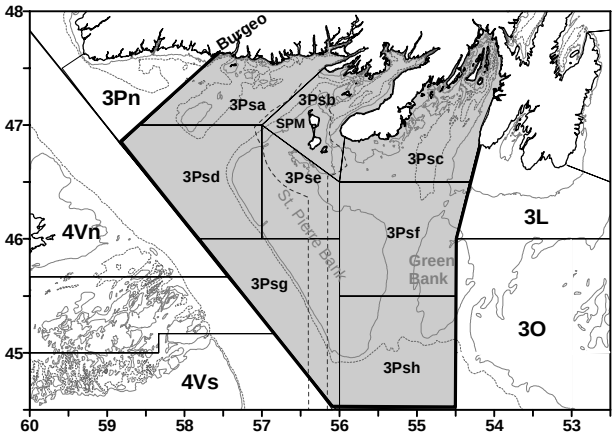


Fig. 1: 3Ps management area (shaded) unit areas (solid lines) and economic zone around the French islands of St. Pierre and Miquelon (SPM) (dashed line).

Context

In the Northwest Atlantic, cod are distributed from Greenland to Cape Hatteras and are managed as 12 stocks. The 3Ps stock off southern Newfoundland extends from Cape St. Mary's to just west of Burgeo Bank, and over St. Pierre Bank and most of Green Bank.

The distribution of 3Ps cod does not conform well to management boundaries and the stock is considered a complex mixture of sub-components. These may include fish that move seasonally between adjacent areas as well as fish that migrate seasonally between inshore and offshore. The extent to which the different components contribute to the fisheries is not fully understood.

Cod from this stock generally grow faster than those from areas further northward. Female cod from this stock are maturing at younger ages in recent years. For example, at least 40% of the females are mature by age 5 (~53 cm) in recent cohorts, compared to only about 10% at age 5 (~58 cm) among cohorts present in the 1970s-early 1980s.

Catches from this stock have supported an inshore fixed gear fishery for centuries and are of vital importance to the area. Fish are caught offshore by mobile and fixed gear, and inshore by fixed gear only. Spanish and other non-Canadian fleets heavily exploited the stock in the 1960s and early 1970s. French catches increased in the offshore throughout the 1980s. A moratorium on fishing initiated in August 1993 ended in 1997 with a quota set at 10,000 t. The TAC was increased to 20,000 t for 1998 and to 30,000 t for 1999. Beginning in 2000, the management year was changed to begin on 1 April. An interim quota of 6000 t was set for January-March 2000. The TAC for 1 April 2000 to 31 March 2001 was set at 20,000 t, but this was reduced to 15,000 t for the next five management years to 31 March 2006. The TAC for 1 April 2006 to 31 March 2007 was reduced to 13,000 t. This stock is normally assessed on an annual basis.

SUMMARY

- Stock status was evaluated from commercial landings (1977 to 31 March 2006) and log-book data (1997-2005) in conjunction with abundance indices from Canadian research vessel (RV) trawl surveys (1972-2005), industry trawl surveys (1997-2005), and sentinel surveys (1995-2005). Exploitation (harvest) rates were estimated from tagging experiments.

- In this assessment a model of the dynamics of the stock using sequential population (SPA) was not accepted and the assessment is based primarily on analyses of survey indices and trends in catch. Therefore, the impacts of fishing at specific TAC levels could not be quantified.

- The RV survey in 2006 was not completed due to unforeseen operational difficulties with the vessels; consequently, there has been no update of the RV index and biological information from this survey.

- All four indices of population size are presently below their average. The two offshore (trawl) indices have been declining, whereas the two inshore fixed gear indices have been stable in recent years.

- Two strong year-classes (1997-1998) are well represented in the catch during 2003-2005. However, these are followed by weaker recruitment (2000-2003 year-classes), and at current catch levels it is anticipated that fishing mortality will increase over the next few years.

- Fish harvesters are of the opinion that the fish stock is healthy and recruitment is good.

INTRODUCTION

Description of the Request for Advice

Advice was requested by Fisheries Management on the stock status of 3Ps cod. Specifically:

- Assess the current status of the stock as a whole. In particular, assess current spawning biomass, total (age 3+) biomass, exploitation rate, natural mortality and biological characteristics (including age composition, size at age, age at maturity, and distribution). Describe these variables in relation to historic observations.

- Further to the previous assessment, analyze the year classes subsequent to the relatively strong year classes of 1997 & 1998 as it relates to the long term growth and sustainability of the stock.

- Assess the implications on the stock by fishing at the 2006 level (13,000 t), and fishing at the 2005 level (15,000 t).

- To the extent possible with available information, provide information on the strengths of year-classes expected to enter the exploitable populations in the next 1-3 years.

- Highlight major sources of uncertainty in the assessment, and where appropriate, consider alternative analytical formulations of the assessment.

- Report on results of tagging and the distribution of this stock in other areas (eg.3L/3Pn).

History of the fishery

The stock was heavily exploited in the 1960s and early 1970s by non-Canadian fleets, mainly from Spain, with catches peaking at 84,000 t in 1961 (Fig. 2).

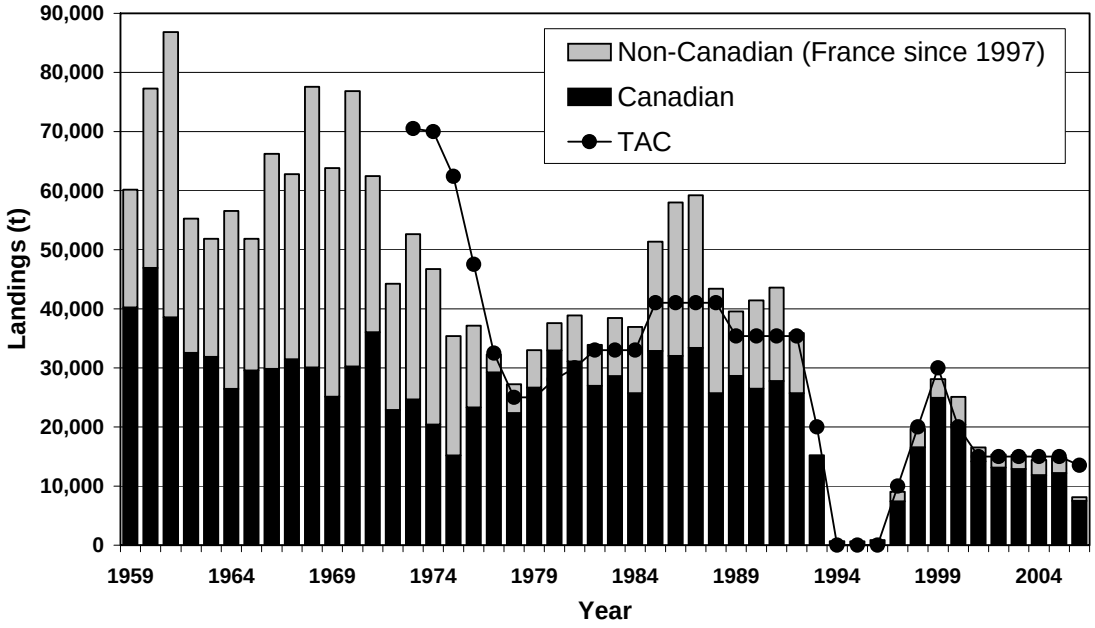


Fig. 2. Reported calendar year landings (t) by country. Note that TAC's are by management year (1 April-31 March) since 2000.

After the extension of jurisdiction in 1977, catches averaged around 30,000 t until the mid-1980s when fishing effort by France increased and total landings reached about 59,000 t in 1987. Catches then declined gradually to 36,000 t in 1992.

A moratorium was imposed in August 1993 after only 15,000 t had been landed. Although offshore landings fluctuated, the inshore fixed gear fishery reported landings around 20,000 t each year up until the moratorium (Fig. 2).

The fishery reopened in May 1997 with a TAC of 10,000 t. This was subsequently increased to 20,000 t for 1998 and to 30,000 t for 1999. In 2000 the management year was changed to begin on 1 April. An interim quota of 6000 t was set for the first three months of 2000. For 1 April 2000 to 31 March 2001 the TAC was set at 20,000 t. For the next five management years ending 31 March 2006 the TAC was set at 15,000 t, but this was reduced to 13,000 t for 1 April 2006 to 31 March 2007 management year.

Landings (000s t)

Year[1]	97	98	99	00[2] (J-M)	00-01	01-02	02-03	03-04	04-05[3]	05-06[3]	06-07[3]
TAC	10.0	20.0	30.0	6.0[2]	20.0	15.0	15.0	15.0	15.0	15.0	13.0
Can.	7.4	16.6	20.4	3.5	20.3	13.2	12.5	12.6	12.1	11.7	5.2[5]
French	1.6	3.1	3.2	4.7[4]	4.7	2.3	2.3	2.4	2.4	2.2	0.5[5]
Totals	9	19.7	23.6	8.2	25.0	15.5	14.8	15.0	14.5	13.9	5.7[5]

[1] During the moratorium (1994-1996) catches were limited to by-catch and sentinel fishery and were <1000 t and are not shown.

[2] During 2000 the management year was changed to begin on 1 April (rather than 1 January) and an interim TAC of 6000 t was allocated for the first three months (Jan.-Mar.) of 2000.

[3] Provisional.

[4] France (St. Pierre and Miquelon) is allocated 15.6% of the TAC but carried forward a portion the 1999 allocation to the first three months (Jan-Mar) of 2000.

[5] Approximate landings to 1 October 2006.

In 2005/06, total reported landings were 13,914 t, mostly (79.6%) from the fixed gear sector (Fig. 3). The total includes a recreational fishery catch of 174 t, and a French catch of 2,165 t, approximately 1,549 t of which was caught by otter trawlers and the remainder (617 t) by fixed gear, particularly gillnets.

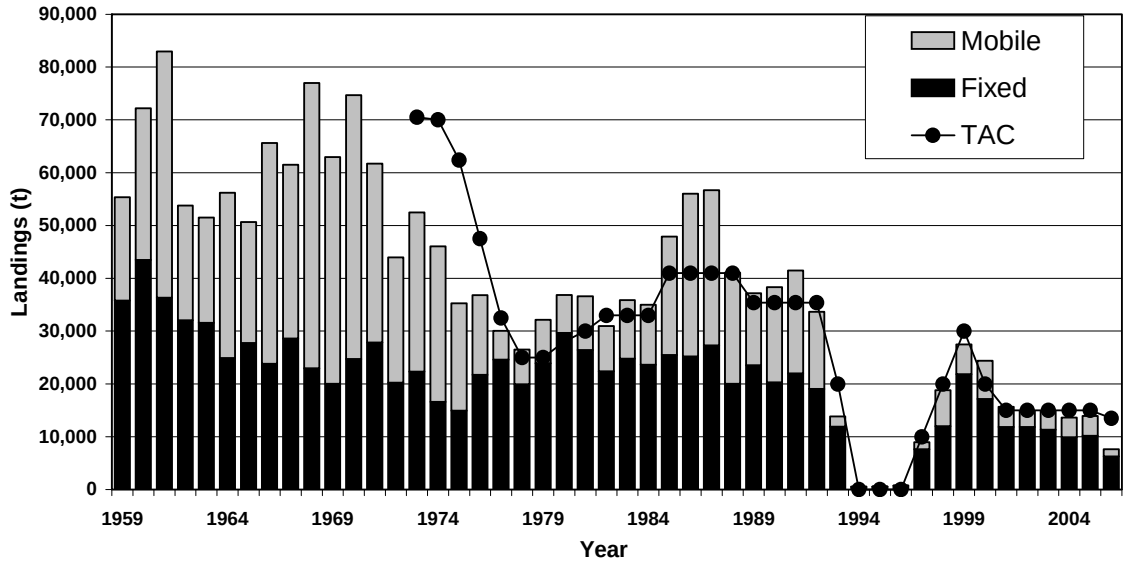


Fig. 3. Reported annual calendar year landings (t) by gear sector. Note that TAC's are by management year (1 April-31 March) since 2000.

During 2005, cod landings comprised a range of ages (mostly 6-9 year olds). The 1997 and 1998 year-classes continue to be strongly represented and together accounted for 50% of the total catch numbers in the 2005 fishery. The number of 8 and 9 year olds has increased, whereas the number of 5 and 6 year olds has decreased compared to the catch in 2004. Ages 7

and 8 were strongly represented in catches of gillnet and otter trawl, whereas younger ages (4-6) were more strongly represented in line trawl catches.

The catch in the first three months of 2006 was taken mostly by offshore mobile gear and was dominated by 8 and 9 year old, i.e. the 1997 and 1998 year-classes that were also prevalent in the catch in 2003, 2004 and 2005.

Species Biology

Stock structure and **migration patterns** of 3Ps cod are complex and poorly understood. Migration of offshore components of the stock to inshore areas during spring and summer, as well as the existence of inshore components that remain outside the research vessel trawl survey areas throughout the year, complicate the assessment of stock status.

Tagging studies initiated in spring 1997 in Placentia Bay were expanded in subsequent years (1998-2003) to include inner and outer Fortune Bay and two offshore areas (Burgeo/Hermitage Channel and Halibut Channel). No inshore tagging has been conducted since 2003, but offshore tagging has continued in 2003-2005 with assistance from industry. Cod tagged inshore were mostly recaptured inshore, even 5-6 years after release. Some cod tagged offshore were recaptured in the inshore fixed gear fishery on the south coast during the summer and fall. Tagging indicated some **movement** of cod between 3Ps and neighbouring stock areas (3Pn4RS, 3KL, and 3NO). A telemetry study conducted from May 2004 to September 2005 to examine mixing of northern Gulf cod (3Pn4RS) into 3Ps showed that 61% of cod implanted with transmitters in the northern Gulf (3Pn4RS) crossed into 3Ps during winter. The peak of movement into 3Ps was in December and the peak of return into 3Pn was in the first two weeks of April.

The following information on species biology was not updated in this assessment because the 2006 research vessel survey was not completed.

Maturation in female cod was estimated by cohort. The proportion of female cod maturing at younger ages has increased over the last two decades. The reasons for the change toward earlier age at maturity are not fully understood but may partly be a response to high levels of mortality and have a genetic component. Males generally mature about one year younger than females but show a similar trend over time.

Spawning is spatially widespread in 3Ps, occurring close to shore as well as on Burgeo Bank, St. Pierre Bank, and in Halibut Channel. Timing of spawning is variable and extremely protracted, with spawning fish present from March until August in Placentia Bay. The proportions of fish at various stages of maturation during the 2004 spring research vessel survey were similar to those observed in recent years.

Growth, calculated from length-at-age in research trawl survey samples, has varied over time. A peak occurred in the mid-1970s for young ages (3-4) and progressively later to 1980 for older ages. From the mid-1980s to the present, length-at-age tended to increase at young ages (2-3) and to vary with no clear trend at older ages. Year-to-year variability at older ages has been considerable (as much as 20 cm at age 10) during the past decade or so. In general, current values of length at age are not unusual in comparison to past values.

The **condition** of cod is typically expressed as W/L^3, where W is the gutted weight or liver weight, and L is the length. Comparison of post-1992 condition with that observed during 1985-1992 is difficult because survey timing has changed. Condition varies seasonally and tends to

decline during winter and early spring. In general, condition of cod in the 1993-2005 surveys shows no clear trend and does not appear to be unusual.

ASSESSMENT

Resource Status

Sources of information: Stock status was updated using data from **commercial landings** to the end of the 2005/06 fishery, and **abundance indices** from Canadian research vessel trawl surveys (1972-2005), industry trawl surveys (Groundfish Enterprise Allocation Council, GEAC), (1997-2005), and sentinel surveys (1995-2005). Catch rate data from logbooks for the < 35 ft sector (1997-2005) and of larger vessels (>35' sector, 1998-2005) were also examined. Annual exploitation rates were estimated from tagging experiments conducted in different regions of 3Ps during 1997-2005.

Research vessel surveys: Canadian research vessel bottom **trawl surveys** were conducted from 1972-1982 by the research vessel A. T. Cameron using a Yankee 41.5 otter trawl. Surveys from 1983 to 1995 were conducted by the Wilfred Templeman, or the sister vessel the Alfred Needler, using the Engel 145 Hi-Lift otter trawl. Since 1996, the surveys have been conducted by the Wilfred Templeman and the Teleost using the Campelen 1800 shrimp trawl. Data collected with the gear used between 1983 and 1995 were converted to Campelen-equivalent units based on comparative fishing experiments. The Canadian research vessel survey was not completed in 2006 due to unforeseen operational difficulties with the vessels.

The survey **biomass index** is variable but declined from the mid-1980s to the lowest values observed during the early 1990s. Values for the post-moratorium period have been higher than those of the early 1990s, but not as high as those of the 1980s (Fig. 4). The biomass index in 2005 was 46,000 t, substantially less than the 2004 survey estimate (80,500 t).

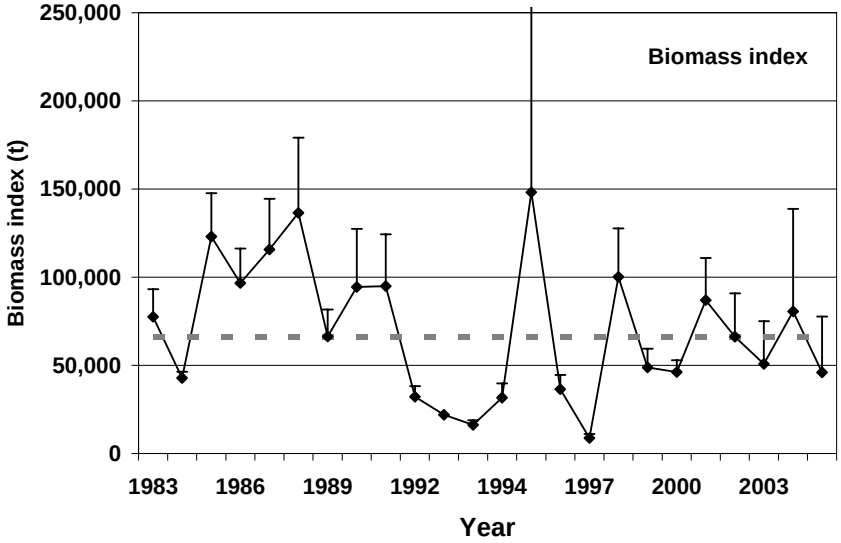


Fig. 4. Research vessel survey biomass index (t) (+1 SD). There were two surveys in 1993 (February and April). The dashed line is the long-term average.

The survey abundance index is variable, but shows a declining trend from the mid-1980s to the early 1990s (Fig. 5). There was a slight upward trend since the early 1990s, but this has reversed in the past four years. The high 1995 estimate was strongly influenced by a single large catch. The 1997 survey was low and did not encounter aggregations of fish that were observed in surveys and commercial catches in subsequent years.

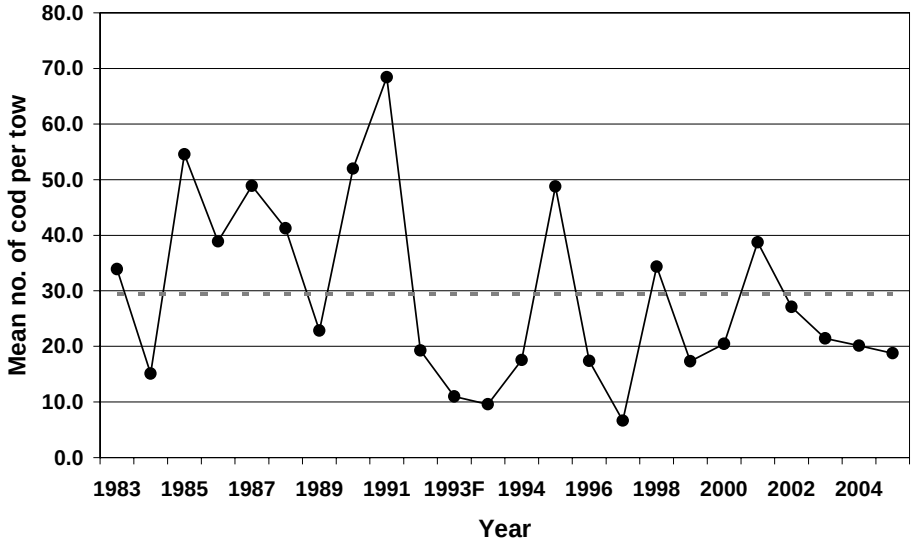


Fig. 5. Research vessel survey abundance index (mean numbers per tow) for 3Ps. There were two surveys in 1993 (February and April). The dashed line is the long-term average.

Age composition: The age range of survey catches over the post-moratorium period has expanded, with the 1989 year-class relatively well represented in the most recent survey at age 16. The 1997 and 1998 year-classes have been strongly represented in the survey index for several years, but are poorly represented in the 2005 survey. The 2000-2002 year-classes also appear weak in the most recent (2005) survey.

Industry (GEAC) trawl survey**:** During fall 2005, an industry trawl survey was conducted with a standardized un-lined commercial trawl. Survey coverage has varied slightly and results for 1997 were from a smaller surveyed area. In all years this survey has shown aggregations of cod in the southern Halibut Channel and on or adjacent to St. Pierre Bank.

The biomass index from the GEAC surveys is variable, but shows a declining trend over the past 5 years. The estimate for 2005 (11.5 Kt) was the lowest in the time series (Fig. 6).

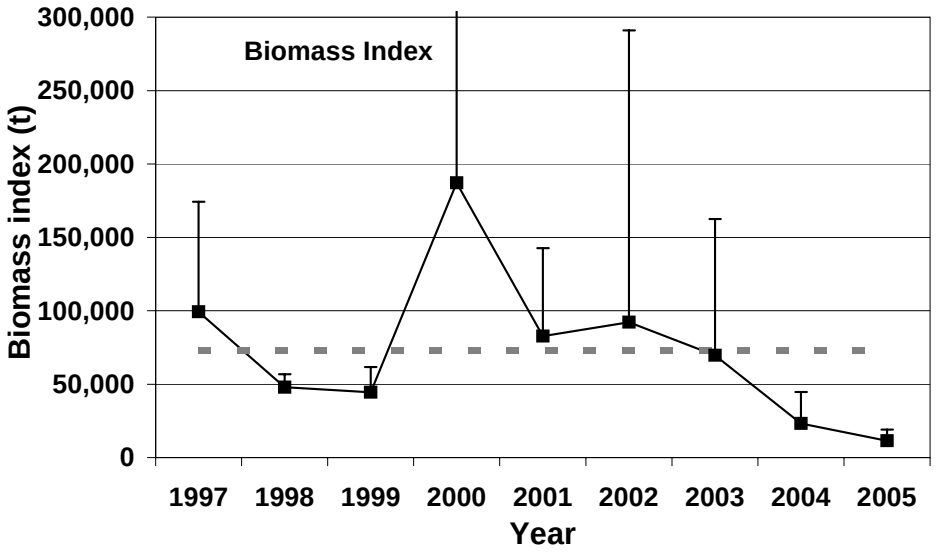


Fig. 6. Biomass index (t) (+1 SD) from the industry (GEAC) trawl surveys. The dashed line is the long-term average.

The abundance index (numbers per tow) from the GEAC surveys has also shown a declining trend in recent years. The estimate for 2005 (5.6) is the lowest in the time-series (Fig. 7).

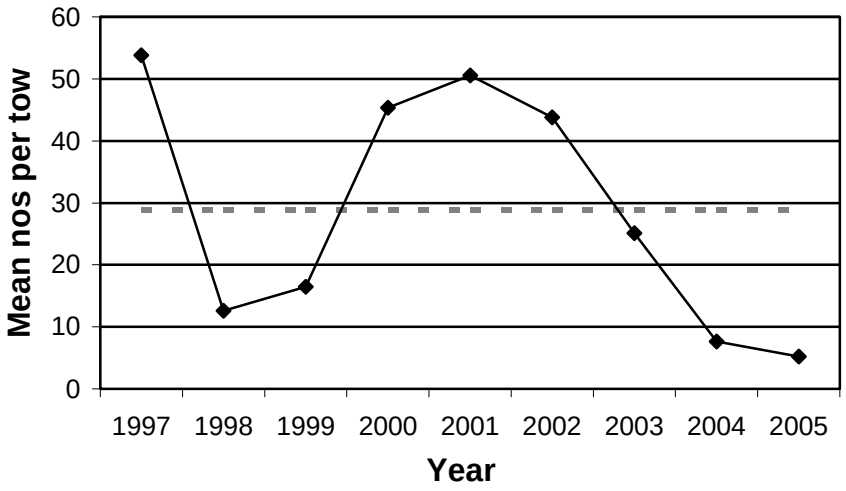


Fig. 7. Abundance index (mean numbers per tow) from the industry (GEAC) trawl surveys. The dashed line is the long-term average.

The 1997 and 1998 year-classes were strongly represented in the GEAC survey index during 2001 to 2003. However, in both the 2004 and 2005 surveys, catches of several older ages, including the 1997 and 1998 year-classes were substantially lower. Recent year-classes (1999-2002) also appear weak.

Sentinel survey**:** Fixed gear **sentinel surveys** have been conducted at several sites along the south coast of Newfoundland from St. Brides to Burgeo from late February of 1995 and are continuing in 2006. However, the 2006 survey is not yet complete and the analysis could not be extended to include the current year.

Gillnet catch rates come mostly from sites in Placentia Bay whereas line-trawl catch rates come mostly from sites west of the Burin Peninsula.

The sentinel survey data were standardized to remove site and seasonal effects to produce annual indices of the total and age-specific catch rates.

The standardized total annual **catch rate index** for gillnets was high from 1995-1997, but progressively lower in 1998 and 1999, and remained low from 2000 to 2005 (Fig. 8, upper panel). The index for line-trawls was high in 1995 with a steady decline to 1999, but has subsequently been fairly constant (Fig. 8, lower panel).

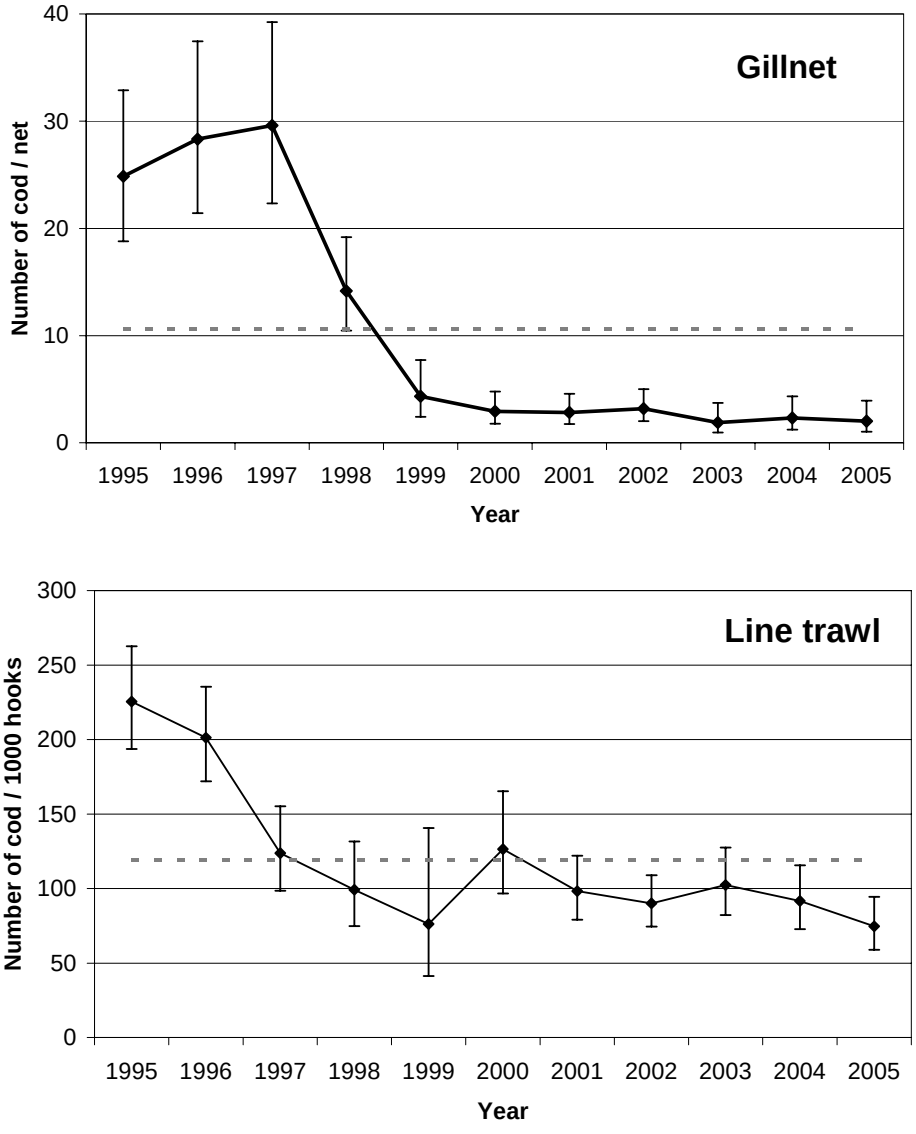


Fig. 8. Standardized sentinel catch rate indices for gillnets (upper panel) and line-trawls (lower panel). Error bars are 95% confidence intervals for the estimates. The dashed line is the long-term average.

The standardized age-specific indices for gillnets and line-trawls show similar trends with the relatively strong 1989 and 1990 year-classes being replaced by subsequent weaker year-classes resulting in an overall decline in catch rates. The 1997 and 1998 year-classes appear to be slightly stronger in the line-trawl and gillnet indices in 2001-2005. Recent year-classes (2000-2002) appear weak.

Log books: Standardized annual catch rates from science log books (<35' sector) for vessels fishing gillnets show a declining trend during 1998-2000, but have subsequently been fairly constant (Fig. 9, upper panel). A declining trend during 1997-1999 was observed for line-trawls, followed by stable catch rates to 2002 and an increase in 2003-2005 (Fig. 9, lower panel). The commercial index is based on weight of fish caught whereas the sentinel index is based on numbers. The percentage of the catch from the <35' sector that is accounted for in the standardized logbook indices has declined over time and now represents only about 30% of the catch as compared to 70% at the start of the time series in 1997.

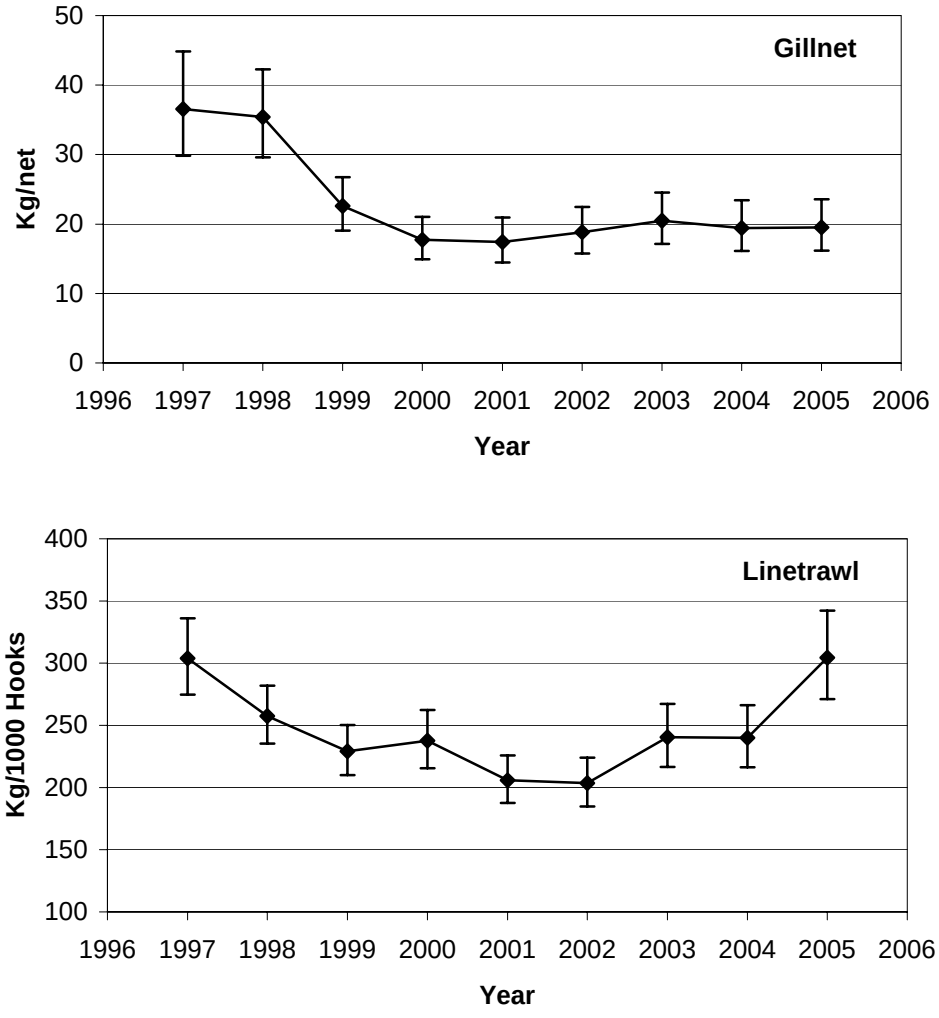


Fig. 9. Standardized catch rates for gillnets and line-trawls from science log books for vessels <35'. Error bars are 95% confidence intervals of the means.

Median annual catch rates by gear sector and unit area from log books of larger vessels (>35' sector) were also examined. The data for gillnets was too sparse for firm

conclusions to be drawn. The otter trawl catch rates showed a declining trend from 1999-2004, but the 2005 values were higher than 2004.

Tagging: Information from recaptures of cod tagged in various regions of 3Ps since 1997 was used to estimate average **annual exploitation (harvest) rates** for cod tagged in specific unit areas. During 2001-2004, the mean exploitation rate was relatively high for cod tagged in Placentia Bay (3Psc, 21-27%) compared to those tagged in Fortune Bay (3Psb, 8-12%), Burgeo Bank/Hermitage Channel (3Psd, 2-8%) or offshore in Halibut Channel (3Psg/h, 1-3%), respectively.

During 2005, mean annual exploitation estimates remained high for cod tagged in Placentia Bay (21%), but were unchanged for cod tagged in Fortune Bay (9%) or Burgeo Bank/Hermitage Channel (1%). Estimates for cod tagged in Halibut Channel were slightly higher (5.5%). The 2005 estimates for inshore tagging are for slightly older fish since cod are normally at least 4 years old when tagged and no inshore tagging has been conducted since 2003.

As in the previous assessment, mean exploitation was low among cod tagged offshore (3Psg/h) in spite of substantial offshore landings. These low offshore exploitation rates are consistent with a large offshore biomass in relation to the magnitude of recent offshore catches. However, the offshore estimates of exploitation are considered uncertain because of the limited timing and localization of offshore tagging coverage and restricted distribution of fishing activity in the offshore. There is also greater uncertainty in the reporting rates of tags from the offshore, and in the survival of fish caught for tagging offshore in deep (>200 m) water.

The timing of offshore tagging coverage was switched from April to December in 2003-2005 to address some of these concerns and to investigate whether winter catches in the offshore portion of 3Ps includes northern Gulf cod. Results indicate that both the percentage of tagged cod returned and distribution of recaptures (all within 3Ps) are similar to those of cod tagged in the offshore of 3Ps during April.

Recruitment: A recruitment index was derived from catch rates of juvenile cod during the industry (GEAC) trawl survey and the DFO research vessel survey. The standardized index indicated considerable annual variability in year-class strength (Fig. 10). Most recent year-classes (2000-2003) as well as those produced in the early 1990's are weak relative to the long-term average and much weaker than year-classes produced during 1997 and 1998.

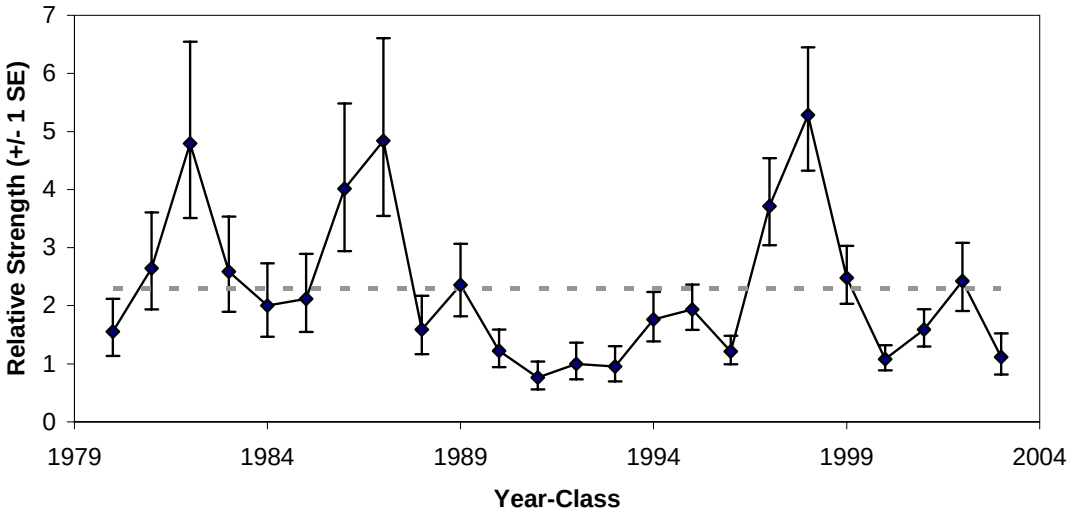


Fig. 10. Standardized year-class strength. The dashed line is the long-term average.

Some information on the relative strength of recent year-classes is also available from the sentinel line-trawl index. This index covers an inshore portion of the stock area. The sentinel line trawl index also shows that most recent year-classes (2000-2002) are weak.

Sequential Population Analyses (SPA): No SPA was accepted due to continued poor model fit to the available indices compounded by the loss of the 2006 research vessel survey which would normally be an integral component of such an analysis. Further progress on a SPA is unlikely without a comprehensive evaluation of indices and model formulations.

Sources of Uncertainty

There is considerable uncertainty regarding the origins of fish found in 3Ps at various times of the year. Tagging and telemetry experiments show that there is mixing with adjacent stocks (southern 3L and 3Pn4RS) and this may vary from year to year. The assessment is sensitive to mortality on 3Ps cod occurring when fish are outside 3Ps and to the incursions of non-3Ps fish into the stock area at the time of the survey and the fishery.

The estimates of exploitation for fish tagged offshore are considered more uncertain because of localized offshore tagging coverage and localized distribution of fishing activity in the offshore. There is also greater uncertainty in the reporting rates of tags from the offshore and possibly in the survival of fish caught for tagging offshore in deep water.

The RV survey in 2006 was not completed; consequently, there has been no update of the RV index and biological information from this survey.

In this assessment a model of the dynamics of the stock using SPA was not accepted and this assessment is based primarily on analyses of survey indices and trends in catch. Therefore, the impacts of fishing at specific TAC levels could not be quantified.

Each of the four indices covers a portion of the stock area and it is not clear whether any index is reflecting trends in the stock as a whole.

There is considerable uncertainty in the interpretation of fishery catch rate data. These data may be more reflective of changes in the nature of the fishery than changes in population size.

ADDITIONAL STAKEHOLDER PERSPECTIVES

In the offshore, fishery catch rates in 2005/06 remained consistent with previous years. Offshore trawler captains reported that in the 2005/06 season cod were found in deeper water earlier than during the previous season. The proportion of large cod in the catch (greater than 10 lbs) declined but there was more market-sized cod. A significant quantity of the offshore large vessel allocation was not taken because of operational problems onshore. There is a perception among captains that the warming trend in ocean temperatures is continuing into 2006 in offshore fishing areas and is a contributing factor to increased fishing for cod in deeper water.

Harvesters attending the meeting noted that catch rates west of the Burin Peninsula are high compared to historically. In Placentia Bay at times during the year there are large aggregations of cod recorded on sounders and catch rates are good. Harvesters attending the meeting who fished on St. Pierre Bank during 2006 noted that there was an increased abundance of cod on the bank from 2005. Observations were based on the high catch rates experienced during 2006 and sounder recordings of cod while prosecuting other fisheries.

Harvesters attending the meeting pointed out that the way the fishery is now prosecuted is far different than prior to the moratorium in 1993. Management plans, seasons and the need to use cod as a by-catch to maximize financial return has changed the way the fishery has been prosecuted in recent years. For these reasons harvesters feel that conclusions based on catch per unit of effort data from commercial log books may not be reflective of changes in stock status.

From the discussions during the assessment meeting it was clear that the good abundance and the healthy cod stock that harvesters see when on the water fishing are not reflected in the graphs of survey data used to assess the stock.

The Fish Food and Allied Workers Union provided an industry perspective on the fishery by conducting a telephone questionnaire of fish harvesters. A total of 174 (17.5%) license holders participated in the survey. Harvesters feel that inshore and offshore catch rates during 2006 were about the same as or better than 2005. Area 10 harvesters rate current catch as being above average compared to historically. Harvesters in area 11 and those who fished on St. Pierre Bank rate catch rates as being high compared to historically. Harvesters said that during 2006, cod were distributed throughout the area and condition was good. Most harvesters say that there was a good mixture of all sizes of cod.

Inshore fish harvesters expressed ongoing concern about the effects of seismic surveys on cod. Seismic testing did not conclude in the 3Ps area until the end of September 2005 and if cod left the area it may have affected the GEAC survey which took place shortly after the seismic operation concluded. Fish harvesters also feel that not enough is known about the short and longer term effects of seismic surveys on all marine species.

CONCLUSIONS AND ADVICE

All four indices of population size are presently below their average. The two offshore (trawl) indices have been declining, whereas the two inshore (fixed gear) indices have been stable in recent years.

Two strong year-classes (1997-1998) are well represented in the catch during 2003-2005. However, these are followed by weaker recruitment (2000-2003 year-classes), and at current catch levels it is anticipated that fishing mortality will increase over the next few years.

Science Considerations

Further progress on a SPA is unlikely without a comprehensive evaluation of indices and model formulations. The complexity of the issue makes this a difficult and time consuming task.

Management Considerations

The incentive for under-reporting of catches remains with the implementation of trip limits, and individual quotas (IQ's). There are also concerns about discarding of small fish due to price differentials based on size.

Because of uncertainties in stock structure, excessive exploitation on sub-components of the stock should be avoided. Measures should be implemented to further reduce the relatively high exploitation rate in Placentia Bay (3Psc) that is evident from analyses of the tagging data, sentinel catch rate indices, and commercial catch rate indices for vessels <35'.

Recent management measures (seasonal closures and switch to individual quotas, rather than a competitive fishery in western 3Ps) have reduced the reported winter catches from the mixing area (3Psa/d combined). Results from a telemetry study confirm that the timing of these closures is appropriate and that catches from this area in winter should continue to be minimized to reduce the potential impact on the 3Pn4RS cod stock.

A complex series of area/time closures on directed cod fishing in 3Ps has been introduced to address concerns about stock mixing and disruption of spawning activity. The consequences of area/time closures should be carefully considered as these may result in higher exploitation rates on the components of the stock that remain open to fishing.

OTHER CONSIDERATIONS

Temperature

There was no temperature information available for 3Ps for 2006 because the research vessel survey was not completed.

Oceanographic information collected during previous spring surveys indicated that temperature during both 2004 and 2005 increased considerably over 2003 values to 1^{o}C above normal in some areas. The areal extent of <0^{o}C bottom waters increased during 2003 to the highest in about 13 years, but decreased during 2004 and 2005 to <10%, the lowest since 1988.

Cold water in the late 1980s and early 1990s was associated with a disappearance of cod from the shallow strata on top of St. Pierre Bank and a shift to deeper water at the time of year when the research trawl survey was conducted. Survey results from 1998-2000, when waters were warmer, indicate some reappearance of cod in these shallow strata; however, in 2001-2003 the numbers of cod in these shallow strata and regions to the east were lower and this pattern persisted into 2004 in spite of the warmer temperatures. During the spring of 2005 there was an increase in the number of non-zero catches on St. Pierre Bank and an apparent increase in the size of the catches in deeper waters with temperatures >2^{o}C.

SOURCES OF INFORMATION

Brattey, J., N. G. Cadigan, B. P. Healey, G. R. Lilly, E. F. Murphy, D, Maddock Parsons, and J.-C. Mahé. 2006. An assessment of the cod (*Gadus morhua*) stock in NAFO Subdivision 3Ps in October 2006. DFO Can. Sci. Advis. Sec. Res. Doc. In prep.

Brattey, J., N. G. Cadigan, B. P. Healey, G. R. Lilly, E. F. Murphy, D, Maddock Parsons, and J.-C. Mahé. 2005. An assessment of the cod (*Gadus morhua*) stock in NAFO Subdivision 3Ps in October 2005. DFO Can. Sci. Advis. Sec. Res. Doc. 2005/070.

Brattey, J. and B. P. Healey. 2006. Exploitation of Atlantic cod (*Gadus morhua*) in NAFO Subdiv. 3Ps: estimates for the October 2006 assessment. DFO Can. Sci. Advis. Sec. Res. Doc. 2006/082.

Colbourne, E.B., E.F. Murphy. 2005. Physical oceanographic conditions in NAFO Division 3P during 2005 - possible influences on the distribution and abundance of Atlantic cod (*Gadus morhua*). DFO Can. Sci. Advis. Sec. Res. Doc. 2005/065.

Maddock-Parsons, D., and R. Stead. 2006. Sentinel surveys 1995-2005: Catch per unit effort in NAFO Subdivision 3Ps. DFO Can. Sci. Advis. Sec. Res. Doc. 2006/074.

FOR MORE INFORMATION

Contact: John Brattey
Fisheries and Oceans Canada
PO Box 5667
St. John's, NL
A1C 5X1
Tel: (709) 772-2001
Fax: (709) 772-4501
E-Mail: bratteyj@dfo-mpo.gc.ca

This report is available from the:

Centre for Science Advice
Newfoundland and Labrador Region
Fisheries and Oceans Canada
PO Box 5667
St. John's, NL
A1C 5X1

Telephone: (709) 772-2302/8892
Fax: (709) 772-6100
E-Mail: wellsn@dfo-mpo.gc.ca
Internet address: www.dfo-mpo.gc.ca/csas

ISSN 1480-4913 (Printed)

La version française est disponible à l'adresse ci-dessus.

CORRECT CITATION FOR THIS PUBLICATION

DFO, 2006. Stock Assessment on Subdivision 3Ps cod. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2006/040.