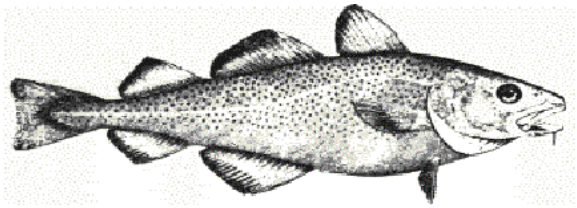
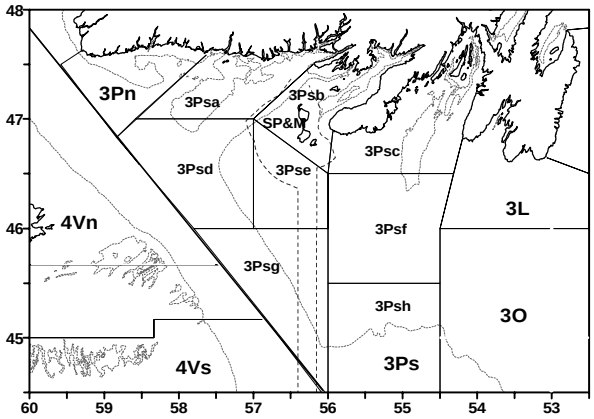


Subdivision 3Ps cod



Background

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. At least 50% of the females are mature by age 5 (~53cm) in recent cohorts, compared to age 6 (~58cm) 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. 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 6,000 t was set for Jan.-Mar. 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 three management years to 31 March 2004.

Summary

- Stock status was evaluated from commercial landings (1977 until 31 March 2003) and log-book data in conjunction with abundance indices from Canadian (1972-2003) research vessel trawl surveys, industry trawl surveys (1997-2002), and sentinel fixed gear surveys (1995-2002). Exploitation rates were estimated from tagging experiments and sequential population analyses.

- During 2002 the age composition of the commercial catch changed markedly from the preceding year. Smaller cod (5 yr olds) dominated the catch, with the percentage of 5 yr old cod in 2002 (24%) approximately twice the 2001 value (13%). There was a corresponding decrease in the percentage of many older age classes.

- During 2002, mean exploitation estimates from tagging experiments declined slightly to 20% for cod tagged in Placentia Bay (compared to 30% in 2000 and 26% in 2001). Mean exploitation estimates during 2002 for cod tagged in Fortune Bay (10%) and Burgeo Bank - Hermitage Channel (5%) were almost identical to those of the two preceding years.

- Spawner biomass estimates for 1 January 2003 from five sequential population analysis formulations ranged from 82,000 t to 185,000 t.

- In all five formulations, spawner biomass was estimated to be higher in 2003 compared to 2002.

- In this assessment the size of the 1997-1999 year classes was estimated to be lower than determined during the 2002 assessment. Consequently the outlook about the short-term productivity of the stock is less optimistic.

- Three-year deterministic projections to 1 April 2006 were carried out for all 5 SPA formulations, for fixed annual TAC options ranging from 10,000 to 20,000 t for the 2004/2005 and 2005/2006 fishing seasons.

- At a TAC of 20,000 t four of five formulations indicate that spawner biomass would decline by 1 April 2006. At a TAC of 15,000 t or 10,000 t three of five formulations indicated that spawner biomass would decline.

- The current projections are consistent with those in the 2002 assessment in that most formulations showed an increase in spawner biomass between 2002 and 2005 although the magnitude of the increase was generally less in this assessment.

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. 1).

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 6,000 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, and for the next three management years ending 31 March 2004 the TAC was set at 15,000 t

Landings (000s t)

Year[1]	77-93 Avg.	97	98	99	2000[2] (J-M)	2000-2001	2001-2002[3]	2002-2003[3]	2003-2004[3]
TAC	-	10.0	20.0	30.0	6.0[2]	20.0	15.0	15.0	15.0
Can.	25.0	7.4	16.6	20.4	3.5	20.3	13.2	12.5	7.0
French	14.7	1.6	3.1	3.2	4.7[4]	4.7	2.3	2.3	0.1
Others	0.03	-	-	-	-	-	-	-	-
Totals	39.7	9	19.7	23.6	8.2	25.0	15.5	14.8	7.1[5]

[1] During the moratorium (1994-1996) catches were limited to by-catch and sentinel fishery and were <1,000 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 6,000 t was allocated for the first three months (Jan.-Mar.) of 2000.

[3] Provisional.

[4] France 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 end of September 2003.

In 2002-2003, total reported landings were 14,800 t, mostly (76.0%) from the fixed gear sector. The total includes a recreational fishery catch of 346 t, and a French catch of 2,300 t, approximately 1,720 t of which was caught by otter trawlers and the remainder (580 t) by fixed gear, particularly gillnets.

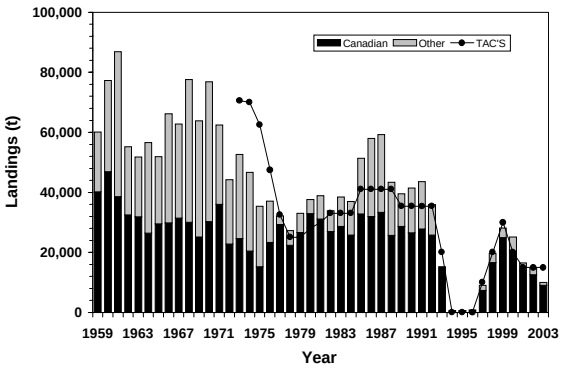


Figure 1. Reported calendar year landings (t) by country. Note that TAC's are by management year (1 April-31 March) since 2000.

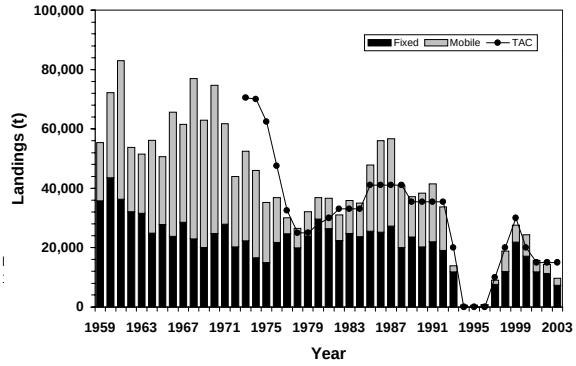


Figure 2. Reported annual calendar year landings (t) by gear sector. Note that TAC's are by management year (1 April-31 March) since 2000.

The **age composition** of the fixed gear catch from 2002 comprised a range of ages from 3 to 15 with most of the catch (in terms of numbers) comprised of 4-8 year olds with age 5 (1997 year-class) predominating. The total catch-at-age strongly reflects the selectivity of gillnets for ages around 6-9. However, the age composition of the commercial catch in 2002 indicates some notable changes from the preceding year. The 1997 year class (5 yr olds) dominated the catch, with the percentage of 5 yr old cod in 2002 (24%) approximately twice the 2001 value (13%). There was a corresponding decrease in the percentage of most older age classes. The increase in 5 year olds was evident in all gear types, including offshore mobile gear.

The catch in the first three months of 2003 was taken mostly by offshore mobile gear and was dominated by 5-7 year olds, with 14 year olds (1989 year class) also well represented.

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.

Annually variable **mixing** of northern Gulf (3Pn4RS) cod with 3Ps cod in the Burgeo Bank-Hermitage Channel area of 3Ps during winter may cause problems with respect to assigning survey and commercial catches to the appropriate stock. The offshore portion of this area (3Psd) has been closed to directed cod fishing from 15 November to 15 April since 1998-1999.

Tagging studies initiated in spring 1997 in Placentia Bay were expanded in subsequent years (1998-2002) to include inner and outer Fortune Bay and two offshore areas (Burgeo/Hermitage Channel and Halibut Channel). In these six years over 60,000 fish were tagged and 10,000 reported as recaptured. Cod tagged inshore were mostly recaptured inshore, even 5-6 years after release. Returns also indicated that some cod tagged offshore were recaptured in the inshore fixed gear fishery on the south coast during the summer and fall. Tagging also indicates some **movement** of cod between 3Ps and neighbouring stock areas (3Pn4RS, 3L, and 3NO).

Maturation in female cod sampled during research trawl surveys was estimated by cohort in the current assessment. The proportion of female cod mature at age has increased among younger cod (Fig. 3). For example, the proportion of 5 year old females that are mature is now the highest in the time series and has increased from about 10-20% in the 1970s and early 1980s to over 80% in the early 2000s. The reasons for the continuing early age at maturity are not fully understood, but changing age at maturity can have considerable influence in the calculation of spawner biomass.

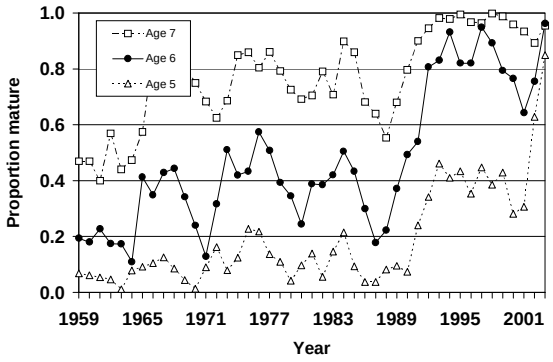


Figure 3. Estimated proportion mature at ages 5-7 (females).

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 2003 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 was 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 with respect 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 1993-2003 surveys shows no clear trend and does not appear to be unusual.

Resource Status

Sources of information

Stock status at the end of March 2003 was updated using age-disaggregated data from **commercial landings** to the end of the 2002/03 fishery, and **abundance indices** from Canadian (1972-2003) research vessel trawl surveys, industry trawl surveys (GEAC, 1997-2002), and sentinel surveys (1995-2002). Age-aggregated catch rate data from logbooks for the under 35' sector (1997-2002) and larger vessels (1998-2002) were also examined. Annual exploitation rates were estimated from tagging experiments conducted in different regions of 3Ps during 1997-2002.

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 using the Campelen 1800 shrimp trawl. Data collected with the gear used between 1983-1995 were converted to Campelen-equivalent units based on comparative fishing experiments.

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 1990's, but not as high as those of the 1980's. (Fig. 4). The biomass index in 2003 was 51,000 t, slightly lower than the 2002 survey estimate.

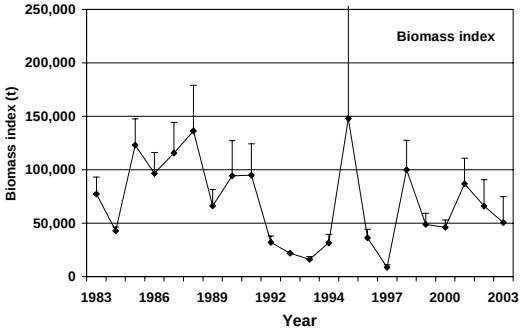


Figure 4. Research vessel survey biomass index (t) (+1 SD). There were two surveys in 1993.

As in previous assessments, for some analyses the survey index was also split into two series, the Burgeo area (western portion) and the remainder of 3Ps (eastern portion) to account for potential mixing with 3Pn4RS cod in the Burgeo area.

The survey **catch rate index** for the western (Burgeo) portion of 3Ps shows no trend during 1993-1998 and an increase thereafter (Fig. 5). The 1998

survey encountered large numbers of 3-5 year old fish that were not strongly represented in subsequent surveys in this area.

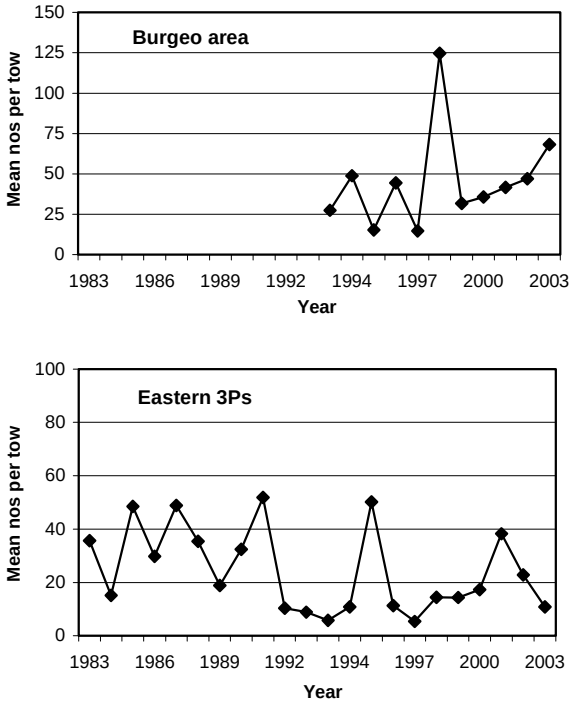


Figure 5. Research vessel survey catch rate index (mean numbers per tow) for the Burgeo area and eastern portion of 3Ps.

The survey catch rate index for the eastern portion of 3Ps is variable, but shows a declining trend from the mid-1980s to the early 1990s. There has been a slight upward trend since the early 1990s, but this has reversed in the past two years. The 1995 catch rate index was strongly influenced by a single large catch and the 1997 survey did not encounter aggregations of fish that were observed in subsequent surveys and commercial catches.

The 1997-1999 year classes have been strongly represented in the Burgeo portion of the survey index for three consecutive years, whereas these year classes have not been strongly represented in surveys and commercial catches from the neighbouring 3Pn4RS stock area. These year classes are also well represented in the index for the eastern portion of 3Ps.

Spatial distribution: During the April 2003 survey, the distribution of cod was similar to that during the 2001 and 2002 surveys. Cod in these recent surveys were less widely distributed across the top of St. Pierre Bank compared to 1999 and 2000 (Fig. 6). The largest catches in 2003 were localized in the southern Halibut Channel, Fortune Bay, and in the Burgeo Bank-Hermitage Channel area.

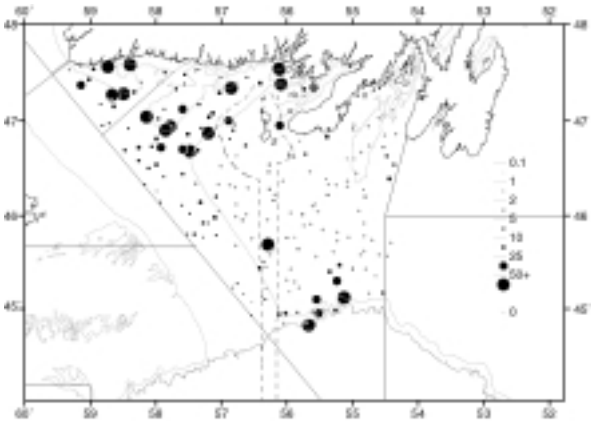


Figure. 6. Spatial distribution of 2003 research vessel trawl survey catches. The scale is numbers of cod per tow.

Age composition: The most numerous ages in the 2003 survey were 4-6 year olds (1997-1999 year-classes). Older ages (> 7) were poorly represented. Survey catches over the post-moratorium period have consistently shown few survivors from year-classes born prior to 1989.

Industry (GEAC, Groundfish Enterprise Allocation Council) trawl survey

During fall 2002 a sixth consecutive industry 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.

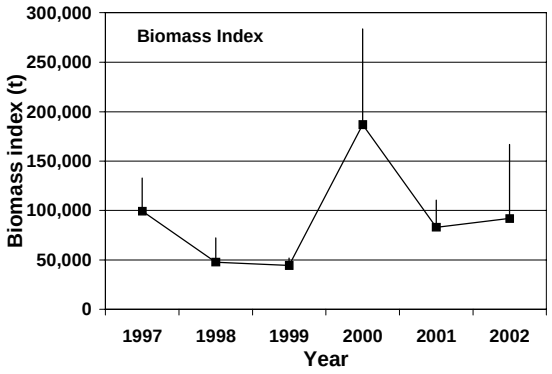


Figure 7. Biomass index (t) (+1 SD) from the industry (GEAC) trawl surveys.

The biomass index from the GEAC surveys is variable with no clear trend over time (Fig. 7).

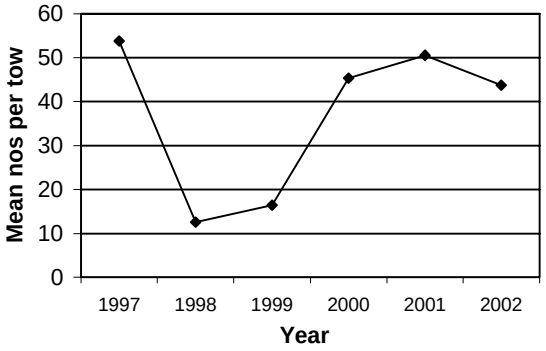


Figure 8. Catch rate index (numbers) from the industry (GEAC) trawl surveys.

The catch rate index (numbers per tow) from the GEAC surveys has also been variable with no clear trend from 1997 to 2002 (Fig. 8).

In the 2002 survey the 1997 and 1998 year-classes are well represented. These results are in general agreement with those from spring research vessel trawl surveys.

Sentinel survey

Fixed gear **sentinel surveys** have been conducted at 16 sites along the south coast of Newfoundland (13 sites in 2003) from St. Brides to Burgeo from late February of 1995 and are continuing in 2003. However, the 2003 survey is not yet complete and the analysis could not be extended to include the current year.

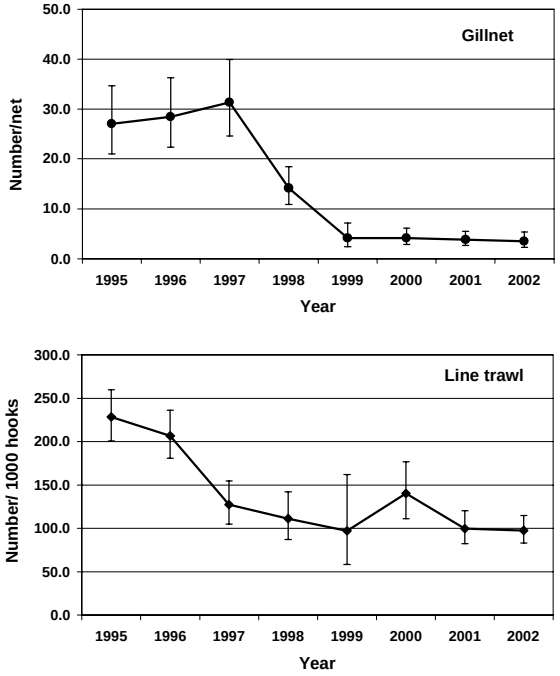


Figure 9. Standardized sentinel catch rate indices for gillnets (upper panel) and line-trawls (lower panel). Error bars are 95% confidence intervals for the estimates.

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 total catch rate and catch rate-at-age.

The standardized total annual **catch rate index** for gillnets shows no clear trend from 1995-1997, but was progressively lower in 1998 and 1999, and remained low from 2000 to 2002 (Fig. 9, upper panel). The index for line-trawls shows a decline from 1996 to 1997, but has subsequently been relatively stable (Fig. 9, lower panel).

The standardized age-disaggregated 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 incoming 1997 and 1998 year-classes appear to be slightly stronger in the line-trawl index in both 2001 and 2002. The 1997 year class appears slightly stronger in the gillnet index in 2002. Catch rates for older fish (age classes prior to 1997) have continued to decline.

Log-books

Standardized annual catch rates from science logbooks (<35' sector) for vessels fishing gillnets show a declining trend during 1998-2000, but have subsequently remained about the same. A declining trend during 1997-1999 was observed for line-trawls, but catch rates have remained about the same since then. The commercial index is based on weight of fish caught whereas the sentinel index is based on numbers.

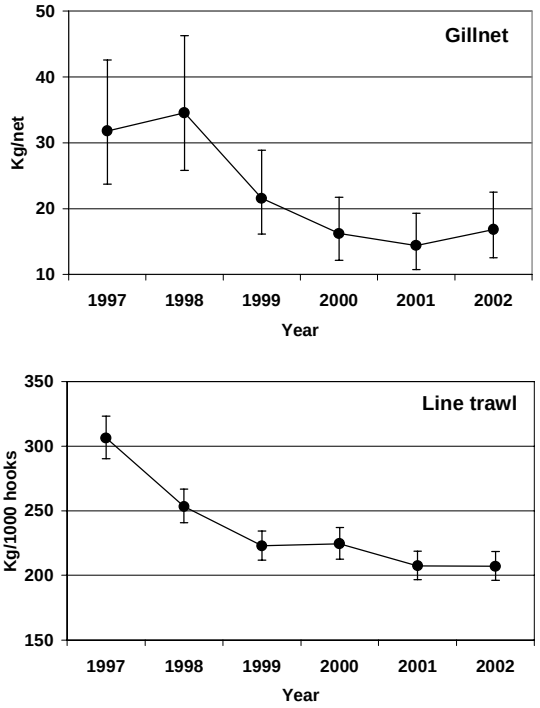


Figure 10. Standardized catch rates for gillnets and line-trawls from science logbooks for vessels <35'. Error bars are 95% confidence intervals of the means.

Median annual catch rates by gear sector and unit area from logbooks of larger vessels (>35' sector) were also calculated. These contain substantially less information, and no information from 1997. The catch rate trends for larger vessels for inshore areas generally agreed with those from the under 35' sector, but those for offshore areas up to 2002 were highly variable, showing no trends.

There have been substantial changes in the management plans in the post-moratorium period, with respect to timing of the fishery, amount of gear fished, trip and weekly limits, as well as a trend toward individual quotas (IQs) rather than

a competitive fishery. In addition, experience has shown that catch rates from fleets operating in the offshore are often a poor reflection of overall trends in stock abundance. Consequently, the data remain difficult to interpret and must be treated with caution in terms of providing information about changes in stock size.

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 2000 and 2001, the mean exploitation rate was relatively high for cod tagged in Placentia Bay (30% and 26%) compared to those tagged in Fortune Bay (10% and 11%), Burgeo Bank/Hermitage Channel (5% and 7%) or Halibut Channel (3% and 2%), respectively.

During 2002, mean exploitation estimates declined to 20% for cod tagged in Placentia Bay, whereas the estimates for cod tagged in Fortune Bay (10%), Burgeo Bank / Hermitage Channel (5%), and Halibut Channel (1%) were almost identical to those of the two preceding years.

As in the 2002 assessment, mean exploitation was much lower among cod tagged offshore (3Psh) throughout 1998-2002 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 localized offshore tagging coverage and localized distribution of fishing activity in the offshore, greater uncertainty in the reporting rates of tags from the offshore, and lower survival of fish caught for tagging offshore in deep (>200 m) water.

Industry perspective

A questionnaire was sent by the Fish, Food and Allied Workers (FFAW) Union to the fish harvesters' committees in 44 communities to provide an industry perspective on the 2002-2003 fishery. Only three committees responded (compared to 45% in 2001); thus insufficient information was provided to obtain an informative industry perspective on the fishery in 2002-2003.

A perspective on the fishery provided by the large vessel mobile gear sector indicated an increase in the abundance of smaller fish and corresponding decrease in numbers of large fish in 2002/2003. No changes in catch rates or distribution of cod were noted.

Other considerations

Temperature

Water temperatures in 3Ps have cooled significantly during the past three years and in 2003 the average temperature was the coldest observed in about 13 years. On St. Pierre Bank, the areal extent of bottom waters with cold temperatures (<0°C) diminished to zero during the warm spell of 1998-2000, but it subsequently increased to over 90% during 2003.

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.

Sequential Population Analyses

Five **sequential population analysis (**SPA**)** model formulations were applied in the current assessment to explore the uncertainty regarding the appropriate model. These constitute the same five model formulations used in the 2001 and 2002 assessments, updated with one more year of data. In addition to the total reported commercial catch, results from DFO RV surveys, GEAC surveys and sentinel surveys were used in the analysis.

Results from the 5 SPA formulations suggest that there is considerable uncertainty about the absolute size of the cod population. The spawner stock biomass estimates for 1 January 2003 for the five SPA sensitivity formulations ranged from 82,000 to 185,000 t.

Trends in population size, and spawner biomass, recruitment, and exploitation are similar among different model formulations. As an example, one of the SPA formulations on ages 2-14 using the catch-at-age from 1977 onwards, and the DFO research vessel survey (non-split), industry trawl survey, and sentinel line-trawl survey as tuning indices is shown to illustrate trends. Population biomass and spawner biomass increased from the late 1970s to a peak in 1985 (Fig. 11). The stock declined from the mid-1980s to the early 1990s, but increased rapidly during the moratorium (1993-1997). Spawner biomass is estimated to have decreased during 1999-2001 and to have increased since then.

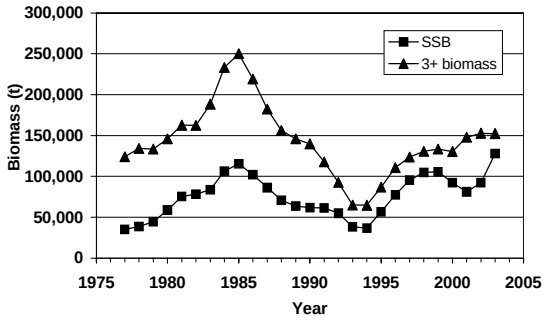


Figure 11. Spawning stock biomass and population (3+) biomass (see Run D in Brattey et al. 2003).

Estimates from the example SPA show that recruitment has been variable in 3Ps, with a long-term decline between year classes in the mid 1970s and the mid 1990s (Fig. 12). SPA estimates indicate that the 1997 to 1999 year class sizes, particularly the 1998 year class, are relatively strong.

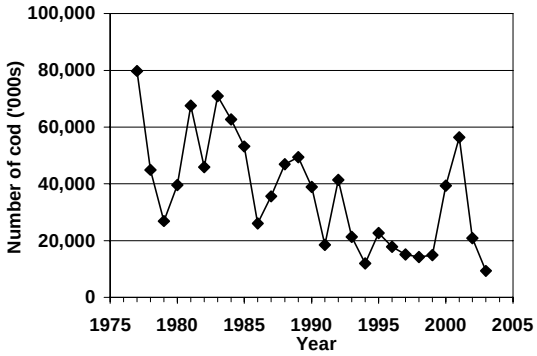


Figure 12. Recruitment (numbers at age 3) (see Run D in Brattey et al. 2003).

Estimates from the example SPA formulation also show that the annual **exploitation rate,** expressed as percentage of 3+ numbers removed by

the fishery, varied over time. Exploitation during the late 1970s to 1985 was typically between 10 and 17%, but increased rapidly to between 20 and 30% just prior to the moratorium in 1993 (Fig. 13). With the reopening of the fishery in 1997, exploitation rates were low relative to the pre-moratorium period and increased to above 10% in 1999, but thereafter have declined to about 5% again.

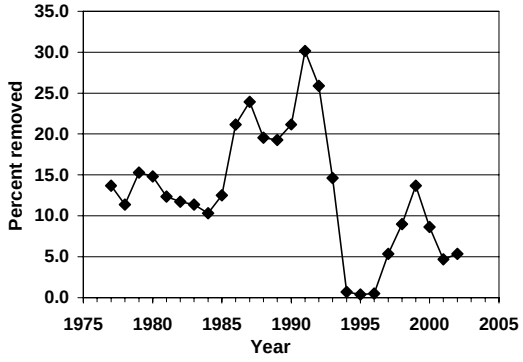


Figure 13. Exploitation rate (see run D in Brattey et al. 2003).

Projections

In the current assessment, 3-year deterministic projections to 1 April 2006 were carried out for all 5 SPA formulations, for fixed annual TAC options ranging from 10,000 to 20,000 t for the 2004/2005 and 2005/2006 fishing seasons. At a TAC of 20,000 t four of five formulations indicate that spawner biomass will decline by 1 April 2006. At a TAC of 15,000 t or 10,000 t three of five formulations indicated that spawner biomass will decline. These projections are consistent with those in the 2002 assessment in that most formulations showed an increase in spawner biomass between 2002 and 2005 although the magnitude of the increase was generally less in this assessment.

Sources of uncertainty

Interpretation of the research vessel survey index is aggravated by past changes in the timing of the survey. In the present assessment, the Burgeo Bank - Hermitage Channel portion of the survey was again treated as a separate index in some analyses due to potential mixing between 3Pn4RS and 3Ps cod extending into April.

Splitting the survey index was intended to reduce the possible influence of northern Gulf cod on the research vessel survey index. However, new information showing synchrony in recent year class strengths between eastern and western 3Ps and general asynchrony with the northern Gulf stock suggests that splitting the index may require further consideration.

There is considerable uncertainty regarding the origins of fish found in 3Ps at various times of year. Tagging experiments suggest that the amount of mixing with adjacent stocks can 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.

As described in the 2001 and 2002 assessments, there is considerable uncertainty regarding the appropriate SPA formulation for this stock. Consequently five different SPA formulations were again evaluated in this assessment to explore this uncertainty.

The sentinel gillnet index and to a lesser extent the line-trawl index show trends that are inconsistent with the SPA and with indices from other portions of the stock area. However, these trends are

consistent with the inshore catch rate data from science logbooks. The reasons for the inconsistencies are unclear, but may reflect the localized nature of the sentinel indices and different fishing mortality and trends on inshore stock sub-components. For example, tagging results suggest exploitation rates in Placentia Bay are higher than in other areas.

The 3 year deterministic projections do not take any uncertainties into account. The trends in the 3 year projections depend heavily on the accuracy of the high estimates of the 1997-1999 year classes, and their subsequent survival and recruitment to the fishery in 2004-2006. These projections are also sensitive to recent changes in estimates of the proportion of females that mature at young ages and become part of the spawning population.

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, greater uncertainty in the reporting rates of tags from the offshore and lower survival of fish caught for tagging offshore in deep water.

Outlook

During 2002 the age composition of the commercial catch changed markedly from the preceding year. Smaller cod (5 yr olds) dominated the catch, with the percentage of 5 yr old cod in 2002 (24%) approximately twice the 2001 value (13%). There was a corresponding decrease in the percentage of many older age classes.

As in previous years the population size in sequential population analyses was found to be very sensitive to model formulations.

Spawner biomass estimates for 1 January 2003 from the five sequential population analysis formulations ranged from 82,000 t to 185,000 t. However, in all five formulations spawner biomass was estimated to be higher in 2003 compared to 2002.

The trends in the 3 year projections depend heavily on the accuracy of the high estimates of the 1997-1999 year classes, and their subsequent survival and recruitment to the fishery in 2004-2006. For example, in this assessment the size of the 1997-1999 year classes was estimated to be lower than in the 2002 assessment and consequently our outlook about the short-term productivity of the stock is less optimistic. These projections are also sensitive to recent changes in estimates of the proportion of females that mature at young ages and become part of the spawning population.

During 2002, mean exploitation estimates declined but averaged 20% for cod tagged in Placentia Bay (compared to 30% in 2000 and 26% in 2001); estimates for cod tagged in other regions were almost identical to those of the two preceding years.

Management Considerations

The incentive for under-reporting of catches remains with the implementation of trip limits, IQ's, as well as size-based and quality-based price differentials. Increased monitoring of catches and

landings would result in better estimates of deaths caused by fishing.

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) to only 260 t during 2002/2003. Catches of such magnitude, irrespective of their stock composition, are unlikely to have a significant impact on the population dynamics of the 3Pn4RS cod stock.

The consequences of further 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.

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