

SUBDIVISION 3Ps COD

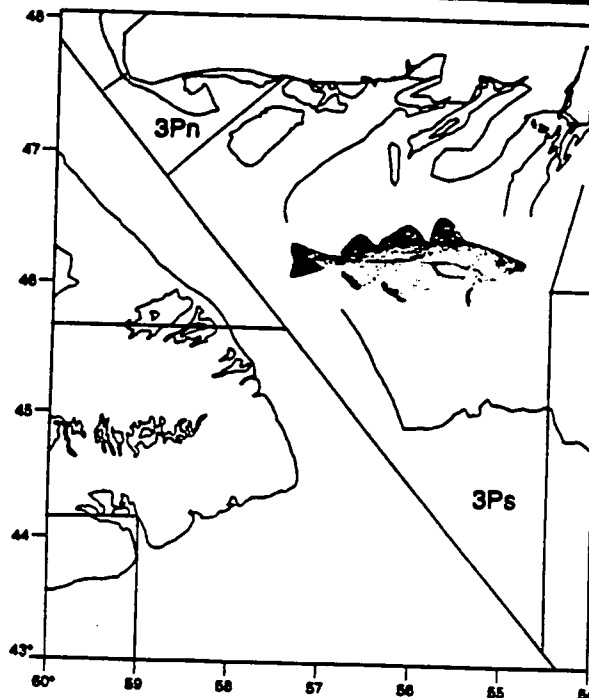
Background

Cod are found on both sides of the Atlantic. In the Northwest Atlantic, they are distributed from Greenland to Cape Hatteras and are managed as 12 stocks. The 'St. Pierre Bank' stock 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 fish does not conform well to management boundaries and the stock is considered to be a complex mixture of subcomponents. These may include fish that move seasonally into the area from adjacent stocks as well as fish that undergo migrations within the area. Fish are caught offshore by mobile gear and inshore by fixed gear. The extent to which the different components contribute to the fisheries is not fully understood.

Cod from this stock generally grow faster than those in more northerly areas. At least 50% of the females have been found to be mature by age 5 (53 cm (21 inches)) in recent years, compared to age 6 (58 cm (23 inches)) in the 1980s.

Catches from this stock have supported an inshore fixed gear fishery for centuries and have been of vital importance to the area. The stock was heavily exploited by Spain and other foreign fleets in the 1960s and early 1970s. French catches increased in the offshore throughout the 1980s. A moratorium on fishing has been in effect since August 1993.

**The Fishery**

The stock was heavily exploited in the 1960s and early 1970s by foreign fleets, mainly from Spain, with catches peaking at 84,000 metric tons in 1961. After the extension of jurisdiction in 1977, cod catches averaged around 30,000 metric tons until the mid-1980s when increased fishing effort by France increased total landings to about 59,000 metric tons in 1987. Catches then declined gradually to 36,000 metric tons in 1992. A moratorium was imposed in August 1993 after only 15,000 metric tons had been landed. Although offshore landings have fluctuated, the inshore fixed gear consistently landed around 20,000 metric tons each year up until the moratorium.

A recreational food fishery was permitted for 8 days in 1994. About 493 metric tons of cod were taken before the fishery was closed, while a further 166 metric tons were taken as by-catch in other fisheries. In 1995 a Sentinel Survey was initiated involving limited fishing by commercial fishers for scientific purposes. Landings totaled

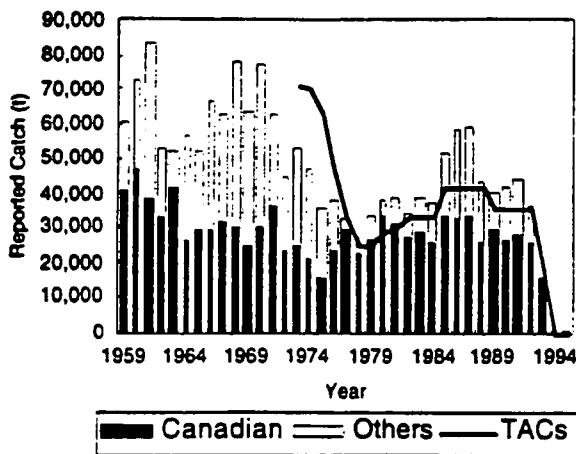
555 metric tons. By-catch accounted for a further 83 metric tons.

Landings (thousand metric tons)

Year	59-76 Avg.	77-90 Avg.	1992	1993 ¹	1994 ¹	1995 ¹	1996 ¹
TAC	-	-	35	20	0	0	0
Can.	30	29	24	15	.7	.6	
Others	28	11	7	+	0	0	
Totals	58	40	31	15	.7	.6	

¹ Provisional

* Catch less than 500 metric tons



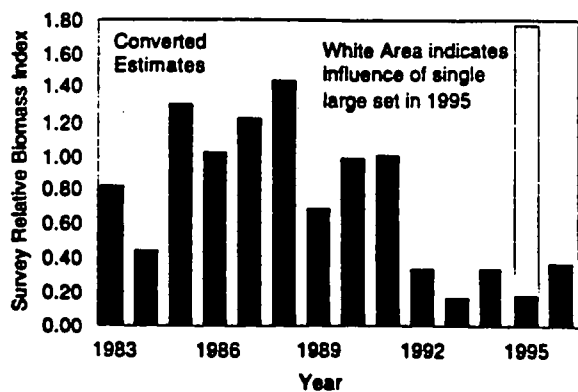
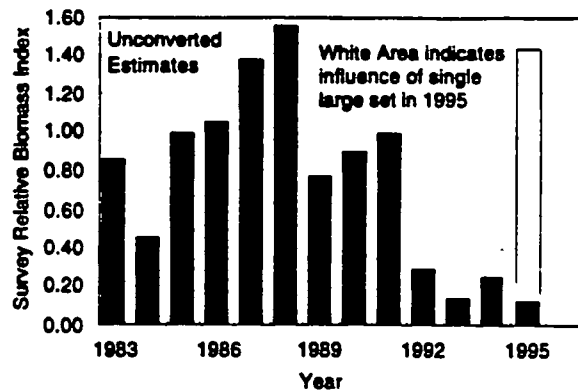
Resource Status

Stock status is estimated mainly using abundance and biomass indices from Canadian (1978-1996) and French (1980-1991) bottom trawl surveys, commercial catch-at-age from purchase slips and port sampling, commercial catch rates from log books of vessels 35 foot to 65 foot fishing fixed gear, and information from the 1995 Sentinel Survey. Data from an acoustic survey in Placentia Bay in November 1995 are also evaluated.

A reliable interpretation of stock status is impeded by severe problems of stock structure, seasonal migrations, variability in trawl survey estimates and poor commercial log book data. Analysis of the information required assumptions to be made which, in the light of these complications, are known to be oversimplified. Nevertheless, a variety of analyses were carried out in an attempt to

extract as much information as possible on stock status from the available data.

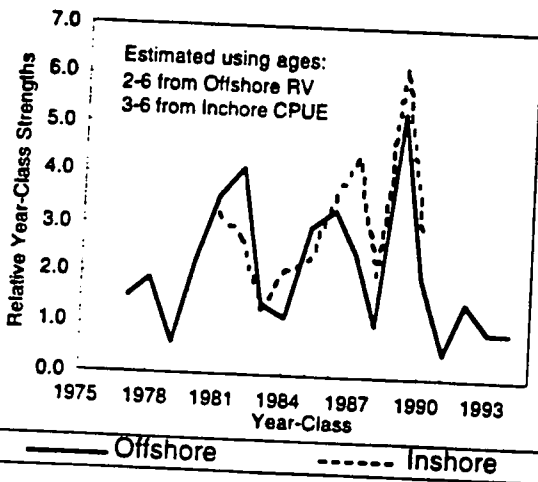
The 1996 spring bottom trawl survey was the first carried out on this stock with the new Campelen 1800 shrimp trawl. Before the results could be compared with past surveys, the time series had to be converted to equivalent units based on the results of extensive comparative fishing experiments carried out with the old and new gear during 1995. The new trawl was found to be much more effective at catching small cod than the old gear but equally effective at catching large cod.



The converted biomass index from 1983 to 1996 shows considerable variability, and is low after 1991. The 1995 estimate is influenced by a single enormous catch contributing 87% of the biomass index. The 1996 biomass index is only slightly higher than the 1994 value. Fish were

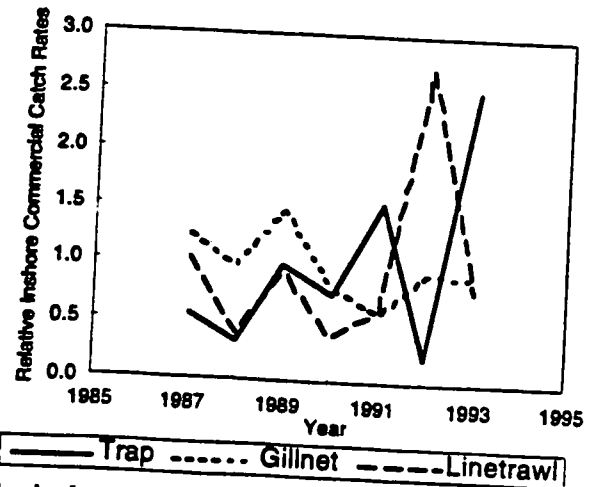
quite widely distributed over the survey area in the early 1980s, including on St. Pierre Bank, but in the more recent surveys have been found mainly on the slopes in the vicinity of Burgeo Bank and south of the Halibut Channel. From 1994 onwards additional strata were surveyed in trawlable areas of Placentia Bay but at the time of these surveys (April) there have been almost no cod in these strata.

An analysis of year-class strength based on 1983 to 1996 trawl survey data for ages 2 to 6 shows that the 1989 year-class is the most abundant, that the 1990 year class is average and that subsequent year-classes are weaker. The 1991 year-class is estimated to be the weakest in the time series. Year-class strength estimated independently from commercial inshore catch rate data for ages 3 to 6 indicate a similar pattern for the period for which the two time series overlap.



Although the relative year-class strength estimates from inshore catch rates and trawl survey catches are similar, the annual average catch rates suggest a different trend in relative abundance in the inshore and offshore in recent years. The inshore catch rates do not reflect the decline in biomass in the early 1990s seen in the trawl surveys. However, it has not been established that inshore catch rates would reflect a decline in biomass were one to occur. Further, the catch rates are quite variable and

contradictory among gears, especially in the last three years, and may not reflect changes in stock abundance.



The inshore catch rate data are only available for vessels 35 to 65 foot and the catch from these vessels for which effort data are recorded represents 2% or less of the fixed gear landings in most years. Inshore catch rate data may not therefore be representative of the inshore abundance of cod.

A fixed gear Sentinel Survey has been conducted at 12 sites along the south coast of Newfoundland from St. Brides to Ramea since late February of 1995 and is continuing in 1996. Sentinel catch rates were low in the first four months of 1995, at an intermediate level in the next four months, and exceptionally high in the last four months. Participants indicated that, overall, the catch rates experienced were better than in the year of closure, but cautioned that they may be artificially high because of the very restricted fishing activity. Commercial and Sentinel fishing practices were so dissimilar that the catch rates could not be combined into a single series.

An acoustic survey conducted in the inner portion of Placentia Bay in November 1995 gave a tentative estimate of 23,000 metric tons. Samples taken by jigger indicated that fish aged 5 and 6 predominated. An attempt was made to extrapolate this biomass to an estimate for the

area covered by the Sentinel Survey, using the ratio of fish density in the acoustic survey to the catch rates experienced by Sentinel fishers. The biomass estimated in this manner exceeded 100,000 metric tons. The errors in this estimate multiply as the consequence of several assumptions, including technical details of acoustics, extrapolation from the ship track to the whole of Placentia Bay, calibration with sentinel catch rates, extrapolation along the length of the coastline and how far fish extend offshore. The estimate was therefore considered to be extremely tenuous.

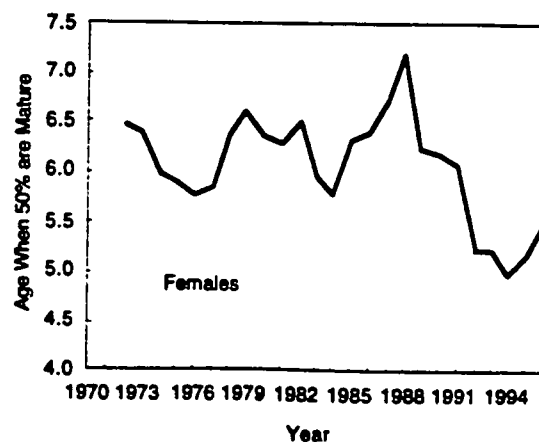
Stock structure and migration patterns of 3Ps cod are complex and not fully understood. The attempts to estimate stock size are complicated by a seasonal influx of cod from adjacent management units, notably the Northern Gulf (3Pn4RS) stock from the west during winter and possibly Southern Grand Bank (3NO) stock from the east and south during fall. Migration of offshore components of the stock to inshore areas during spring and summer, as well as the possible existence of inshore components that remain outside the survey areas throughout the year, also complicate the assessment of stock status. Tagging studies suggest that at least five components contribute to commercial catches in 3Ps; these include cod from the Northern Gulf, Burgeo Bank, southern St. Pierre Bank, Southern Grand Banks, and the inshore Avalon-Burin stock complex.

Sequential population analysis has been unable to reconcile total catch with offshore trawl survey estimates in recent assessments. Therefore in this assessment separate reconstructions were attempted from inshore fixed gear catches and offshore trawl catches from 1978 to the present. The basis for this is the hypothesis that there may be only limited mixing between these two components of the stock, as indicated by the difference in trawl

survey estimates of abundance and inshore catch rate trends in recent years.

An attempt was made to calibrate the offshore analysis with the research trawl estimates; however the results were not considered satisfactory. Calibration of the inshore analysis with fixed gear catch rates from gillnets, linetrawls and traps for the period 1987 to 1993 suggested that this analysis was worth taking further. The biomass of cod in the inshore in 1993 was estimated to be about 100,000 metric tons, up from a low of about 80,000 metric tons in the late 1980s. In each of the years 1991 to 1993 there was one index, either line trawl or trap, that was very high and out of line with the other two. As noted previously, there are a number of concerns that high catch rates observed for these gears may not reflect stock abundance.

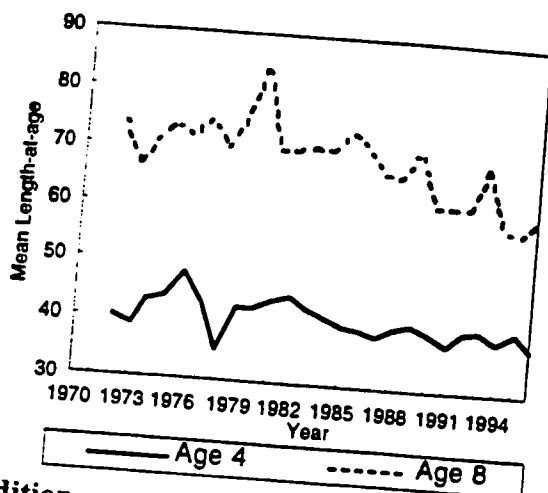
Given the uncertainty associated with the inshore catch rate time series used in the calibration, the estimates of inshore cod abundance were considered to be too unreliable to use in assessing stock status.



Age-at-maturity from trawl survey samples has typically averaged 6 years (58 cm (23 inches)) but has been declining in recent years. Age at 50% maturity for females dropped dramatically from a high of 7.2 years (65 cm (26 inches)) during 1988 to a low of 5 years (53 cm (21 inches)) during 1994. However, the

estimates for the two most recent years indicate that the declining trend has reversed or at least halted with current (1996) estimates of age-at-50% maturity at 5.5 years (56 cm (22 inches)). Males show a similar trend although maturation generally occurs about 1 year younger for males. Maturities at age in the 1995 Sentinel Survey are almost identical to those found in the trawl survey.

Growth, calculated from length-at-age in trawl survey samples, varied with no trend (younger ages) or declined (older ages) during the past decade.



Condition, as measured by gutted body weight and liver weight relative to body length, was low in fish sampled during the 1993-1996 surveys. However, it is not clear that the values were below normal, because the 1993-1996 surveys were conducted in April when condition is near the low point of the seasonal cycle, and only two of the earlier surveys (1978-1992) were conducted during April. The condition of fish sampled from the sentinel survey varied seasonally and spatially. Comparable data must be collected for several years before deviations from the norm can be detected. Sentinel fishers reported that fish were in good condition.

The age composition in both the survey and fixed gear catches indicate a sequential loss of older ages from the population. Further loss of

older age classes has occurred even after the moratorium was imposed.

Environmental Factors

Time series of temperature anomalies at depths less than 75m show cold periods in the mid 1970s and since the mid 1980s, similar to conditions on the shelf along the east coast of Newfoundland. The most recent cold period, which started around 1984, continued in the early 1990s with temperatures up to 1°C below average, and up to 2°C below the warmer temperatures of the late 1970s and early 1980s in the surface layers. Temperatures in deeper water off the banks show no significant changes. Since 1991, temperatures have moderated somewhat in some areas, but large areas continued to have anomalously cold temperatures in 1995, particularly on the eastern portion of St. Pierre Bank. Results from the spring 1996 survey suggest that conditions are returning to more normal levels.

Major Sources of Uncertainty

The origins of fish that make up the 3Ps cod fishery are diverse and as yet not fully understood. This complicates the interpretation of trawl survey, Sentinel Survey and commercial catch data and reduces confidence in the results of sequential population analysis.

Catch rate information from the inshore fishery is only available for the period 1987 to 1993 and represents only a small percentage of the annual catch. There is considerable uncertainty in the interpretation of these data.

The catch rates experienced in the Sentinel Survey in the last four months of 1995 are much higher than those reported in the inshore fishery from 1987 to 1993. However, catch rates in the early part of 1995 were below average. There is considerable uncertainty in the correct interpretation of Sentinel Survey catch rates in terms of the current status of the stock.

Reasons for distrusting any extrapolation of the acoustic survey results from Placentia Bay are discussed above.

The timing of the trawl survey has varied considerably over the years. This introduces uncertainty in the interpretation of abundance estimates and trends in fish condition because of seasonal migration patterns and seasonal changes in the biology of cod.

The decline in cod abundance observed in offshore surveys is not compatible with catch rate time series in the inshore, results of the Sentinel Survey, and perceptions of fishermen. This introduces uncertainty in the interpretation of these data.

Introduction of the new trawl survey gear raises hopes for making more reliable estimates of year-class strength at younger ages. However, the uncertainties inherent in the low catches of small fish in the old gear can never be removed.

Outlook

The results of the trawl surveys suggest that the biomass of cod in the survey area declined to a low level in 1993 and may have increased only modestly since then. This decline and continuing low biomass in the offshore conflicts with trends in inshore catch rates and results of the 1995 and early 1996 Sentinel Survey. The perception of many fishers is that there has been a good recovery of the stock in the inshore in the last two years. They point to increased by-catch, sightings and sounder-recordings as supporting evidence.

A re-opening of the offshore fishery is not supported by trawl survey data.

Given the uncertainties and the lack of a firm conclusion on current stock size in the inshore, it would be necessary to get more positive signs before considering a re-opening of the fixed gear fishery at historical levels. There is an unquantified risk of over-exploitation,

particularly if these components are restricted to localized areas such as Placentia Bay.

Based on the available data, a limited re-opening of the inshore fixed gear fishery may not compromise the recovery of the stock. However, the current state of the stock makes it particularly sensitive to the risk of depletion for the following reasons:

- fish abundance is low offshore and any contribution to the inshore is severely reduced;
- if the stock is dependent on a wide distribution of ages for spawning success, this wide distribution no longer exists and therefore recruitment success may be reduced;
- there are no signs of good recruitment subsequent to the 1989 year-class;
- information from fixed gears is limited to the nearshore and may not indicate a large total resource;
- although inshore information has not indicated a decline it has not been established that the indices are capable of indicating a decline were one to occur.

Given the uncertainties and risks associated with re-opening, as outlined above, prudence must be exercised in considering possible catch levels during the first year of any limited re-opening.

In the event of a reopened fishery steps should be taken to ensure that a number of different biological variables such as lengths, ages (otoliths) and maturities are very well sampled. Steps should be undertaken to enable provision of frozen samples of catches from different gears/areas throughout the year so as to enable more detailed biological sampling. In addition, detailed log-book information accurately reflecting catches and associated effort should be

gathered from all vessel sizes involved in the fishery.

For More Information

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Rose, G.A. 1996. Preliminary report of an acoustic survey of inner Placentia Bay, November 1995. DFO Atl. Fish. Res. Doc. 96/96.

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