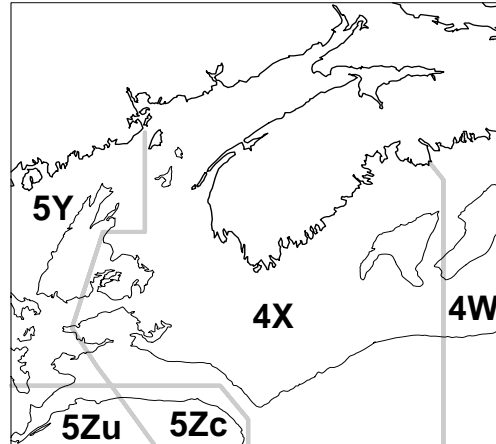




**SOUTHERN SCOTIAN SHELVE  
AND BAY OF FUNDY COD**



**Background**

Atlantic cod is a bottom dwelling fish occurring on both sides of the North Atlantic. In the Canadian Atlantic, cod range from northern Georges Bank to northern Labrador. There are several concentrations of cod within this range, one of which occurs in the southern Scotian Shelf and Bay of Fundy (NAFO Division 4X).

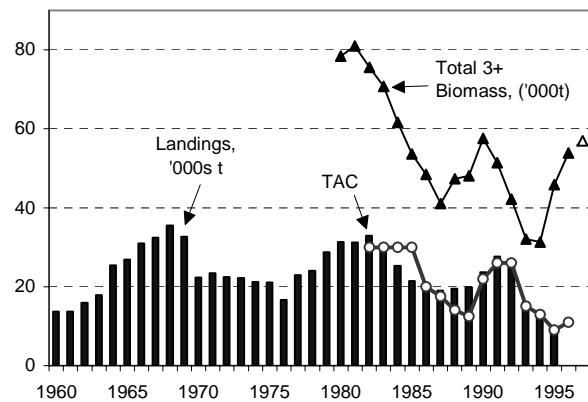
Juvenile cod in Division 4X feed on a wide variety of invertebrates and as they grow include fish in their diet. Seasonal movements associated with spawning occur and a number of spawning areas exist in Division 4X with the largest occurring during winter on Browns Bank. Growth rates vary among cod in Division 4X with more rapid growth noted in the Bay of Fundy. Cod in Division 4X reach on average 53 cm (21 inches) by age 3 years and increase to 72 cm (29 inches) by age 5 and 110 cm (43 inches) by age 10. Age at first reproduction generally occurs at 3 years and individuals tend to spawn several batches of eggs during a single spawning period.

Cod in Division 4X has supported a commercial fishery since the 1700s and until the 1960s was primarily an inshore fishery. Following extension of jurisdiction to 200 miles by coastal states in 1977, only Canada has made substantial landings of cod from this area. Minimum mesh size and hook size regulations have been enacted to reduce the catch of juvenile cod. Spawning area/seasonal closure of Browns Bank is in place from 1 February-15 June. Scientific advice is presented on the basis of a target capture rate of roughly 16% of the population.

**The Fishery**

Landings (thousands of tonnes)

Year	70-79 Avg	80-89 Avg	1991	1992	1993	1994	1995	1996
TAC	-	-	26	26	15	13	9	11
Total	23	24	26	26	16	13	9	



Landings increased through the 1960s from 14,000t to 36,000t as large offshore trawlers became active in the fishery.

Since 1970, landings have varied between about 16,000t and 33,000t, reaching their lowest level of 9,000t in 1995. These landings

are a reflection of the Total Allowable Catch, which declined from 26,000t in 1992 to 9,000t in 1995. The TAC increased to 11,000t for 1996, 4,000t of which were landed by the end of June. The fishery takes place year round, with catches peaking in June and July, and is prosecuted predominantly by tonnage classes 2 and 3 otter trawlers, along with tonnage class 1 and 2 longliners and handliners. The distribution of landings in 4X has shifted west in recent years, with landings from 4Xmno declining to a greater degree since 1992 than in other areas.

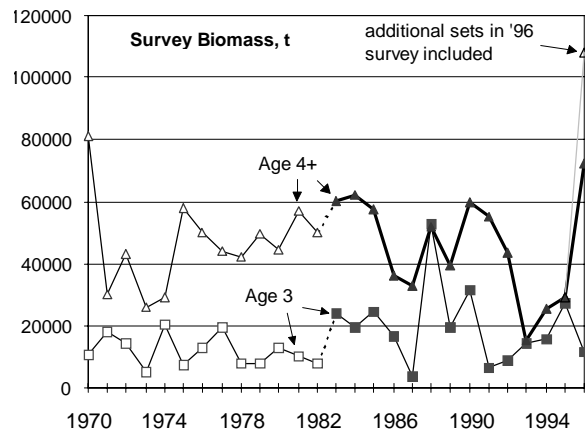
In the first half of 1996, landings were dominated by the strong 1992 year-class (age 4, 22-28in) which accounted for 60% of the cod landed. Although the population abundance of age 6+ cod is low, recent declines in the proportion of landings comprised of older cod are likely due in part to reduced fishing effort during the winter-spring fishery when the proportion of large cod in the catch is generally highest.

### Resource Status

**Stock status evaluation** was based on an analysis using landings statistics, samples for size and age composition of the commercial catch, and trends in abundance from the July research survey. While analyses have been conducted using commercial catch at age data prior to 1980 in previous assessments, commercial sampling for this period was sparse, and the catch at age as it has been reconstructed for this period is considered unreliable. Thus, although it may be possible to develop a more reliable catch at age for at least part of this time span, these data have not been considered in recent assessments.

Suspected uncertainties in relative fishing power among survey vessels could contribute to the undesirable patterns observed in the comparison between survey and VPA estimates of abundance (the pattern suggests survey

results from vessels used before 1983 may provide a relative underestimate of biomass). Excluding survey data prior to 1983 eliminated the retrospective pattern (a discrepancy between past estimates of stock status and current estimates using additional data); consequently, only survey data since 1983 have been used in recent assessments.

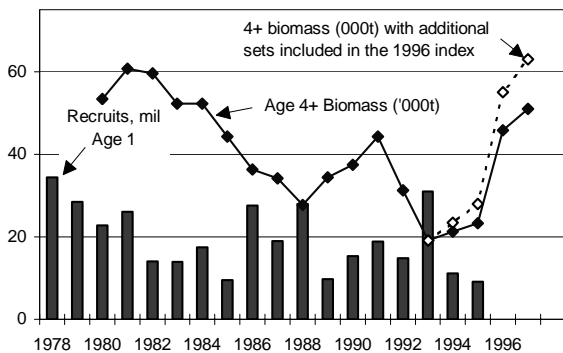


The 1996 **research vessel (RV) survey** biomass for ages 4 and older combined increased in 1996 to the highest level seen. This increase was apparent in both the Bay of Fundy (4Xqrs, 5Y) and Scotian Shelf (4Xmnop) areas. Survey biomass estimates for ages 2 and 3 (1993 and 1994 year-classes) are quite low. Due to problems with computer data storage, some survey data were lost. All data required to produce the 4X cod indices were retained; however, 4 stations were repeated to replace information lost for other species. If the cod catches from these 4 additional sets are included, the survey age 4+ biomass for 1996 increases considerably. This increase is due to the influence of one very large set, the second largest catch of cod in the survey series.

A mobile gear survey (**ITQ survey**) was conducted by the ITQ fleet in 4X in 1995 and 1996, concurrent with the RV survey. The ITQ survey covered most of the 4X area, including much of the inshore area which is not covered by the RV survey. The geographic pattern of

cod catches in the ITQ survey was similar to those from the RV survey, however, there was little change in catch per tow between years. Catch per tow was much lower in the RV survey in 1995, and more similar to the ITQ survey in 1996.

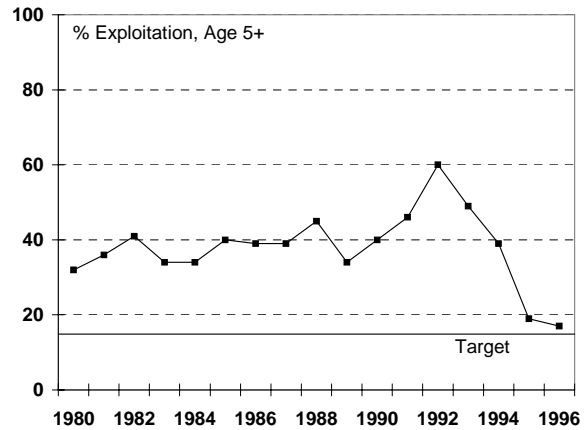
**Population abundance** estimates indicate that the stock continued to increase in 1996. The beginning of year population biomass for ages 4+ peaked in 1991, then dropped to the lowest levels in the time series in 1993 and 1994. The increase in 1996 is primarily due to recruitment of the very strong 1992 cohort. Assuming that the 1996 TAC of 11,000t is caught, the beginning of 1997 age 4+ biomass should reach 51,000t, a level not reached since 1984, and more than double the low of 19,000t seen in 1993. If the higher survey index is used, the 1997 age 4+ biomass estimate increases to 63,000t. The lower of these two estimates is considered more reliable as the higher estimates of year-class strength seem inconsistent with previous estimates. Also, the ITQ survey showed little change from 1995.



**Recruitment** following the 1992 year-class looks quite poor, with both the 1993 and 1994 year-classes estimated as below average.

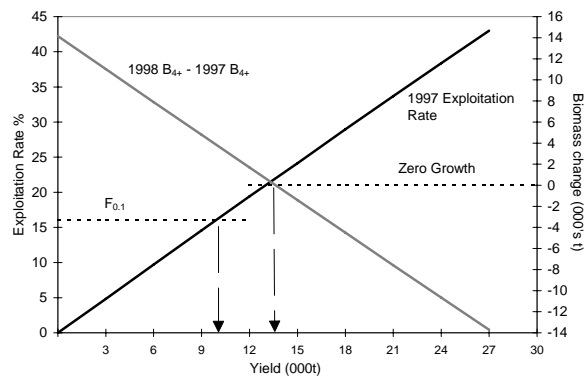
The exploitation rate throughout most of the recent past has consistently been well over twice the target of 16%, reaching a high of 60% in 1992. Exploitation rate has declined markedly since then, to 19% in 1995. Exploitation rate is lower than the 26%

anticipated in last years assessment, and the population biomass is higher than was forecast.



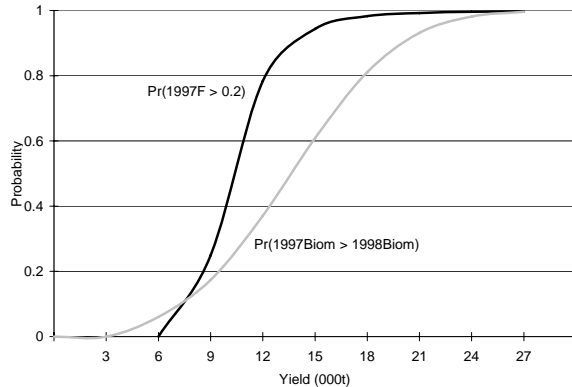
**Outlook**

The expected catch of about 11,000t in 1996 will result in an exploitation rate of 17%, roughly equal to the target exploitation rate of 16%. The projected yield at the target exploitation rate for 1997 would be about 10,200t, 45% of which is expected to come from the 1992 year-class. Assuming that the fishing rate can be achieved, the age 4+ biomass is projected to increase by 3,000t in 1997 to about 54,000t at the beginning of 1998, a level not seen for this stock since 1982.



Though all uncertainties and biases cannot be incorporated, the statistical precision of the abundance estimate was approximated, and used to evaluate the risk that specific catch levels in 1997 would exceed  $F_{0.1}$ , or result in a decline in age 4+ biomass from 1997 to 1998.

At a yield of 10,200t which corresponds to a 50% risk of exceeding  $F_{0.1}$ , the 4+ population biomass has an 80% probability of increasing for 1998; this probability declines to 50% at a yield of about 13,500t.



Using the higher possible survey index to estimate population abundance would result in an  $F_{0.1}$  yield projection for 1997 of 12,400t. If the lower population estimate is appropriate, a yield of 12,400t would increase the risk of exceeding  $F_{0.1}$  for 1997 to almost 100%, though the risk of a decline in 4+ biomass from 1997 to 1998 would only be 40%.

### *For More Information*

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### *References*

Clark, D.S. 1996. Assessment of cod in Division 4X in 1996. DFO Atl. Fish. Res. Doc. 96/101.