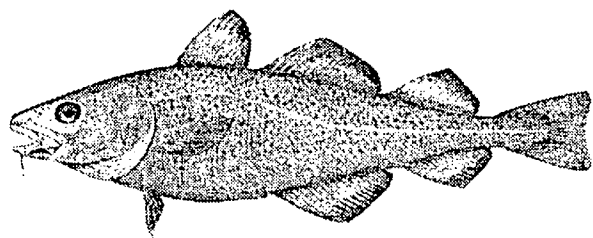


**Fall Update of 4X Cod
and Haddock Stock Assessments**

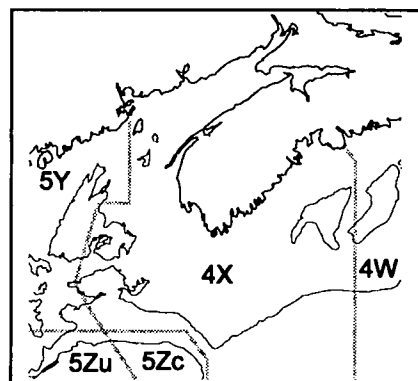
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Original



SOUTHERN SCOTIAN SHELF 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.

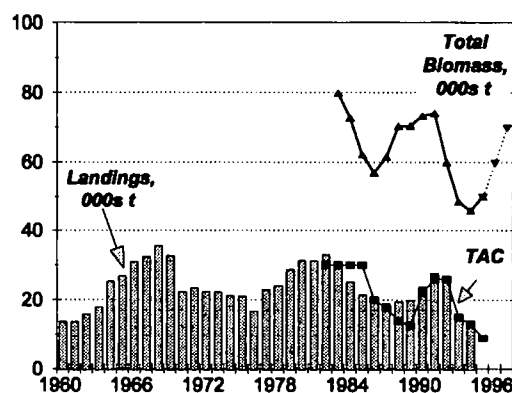
Cod in Division 4X has supported a commercial fishery since the 1700s and until the 1960s was primarily an inshore fishery. Following extension of jurisdiction to 200 miles by coastal states in 1977, only Canada has made substantial landings of cod from this area. Minimum mesh size and hook size regulations have been imposed to reduce the catch of juvenile cod. Spawning area/seasonal closure of Browns Bank is imposed 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	71-80 Avg.	81-90 Avg.	1991	1992	1993	1994	1995
TAC	-	-	26	26	15	13	9
TOTAL	23	24	28	26	16	13	4*

* January - June 1995



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 13,000t in 1994. These landings are a reflection of the Total Allowable Catch, which declined from 26,000t in 1992 to 13,000t in 1994 and has been further reduced to 9,000t for

1995, of which 4,000t 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 otter trawlers of tonnage classes 2 and 3, and longliners of tonnage classes 1 and 2. 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.

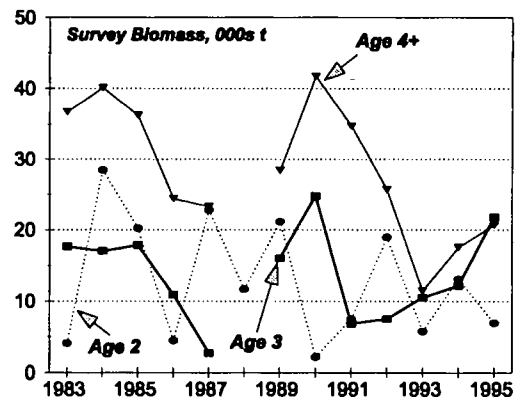
In the first half of 1995, the 1992 year-class (age 3, 53cm, 21in), the 1991 year-class (age 4, 63cm, 25in), and the 1990 year-class (age 5, 75cm, 30in) all made significant contributions to the commercial landings. Although the abundance of age 6+ cod is low, recent declines in the proportion of landings comprised of older cod is likely due in part to reduced fishing effort during the winter-spring fishery when large cod were commonly harvested.

Resource Status

Stock status evaluation was based on an analytical assessment 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 data prior to 1983 in previous assessments, commercial sampling in the 1970s was sparse, and it was concluded that the stock history could not be reliably reconstructed for this period. Furthermore, suspected uncertainties in relative fishing power among the different survey vessels could contribute to the observed residual patterns (predominantly positive since 1983 and negative before 1983). Preliminary analysis excluding data prior to 1983 also indicated that this approach would eliminate the retrospective pattern (a discrepancy between past estimates of stock status and current estimates using additional data). Based on these considerations,

the present assessment was conducted using data from 1983-1995.

The 1995 **research vessel (RV) survey** biomass for ages 4 and older combined is higher than in 1994, but remains low for the time span 1983-1995. However, age 3 biomass (1992 year-class) in 1995 is very high. Increases in the survey catch over 1994 occurred in both the Bay of Fundy (4Xqrs, 5Y) and Scotian Shelf (4Xmnop) areas, however catches remained poor east of Browns Bank. The Bay of Fundy has generally accounted for 30-40% of the overall index of abundance in 4X, however in 1994 it made up over 60%, and in 1995 about 50%, largely due to good catches of age 3 and 4 fish in both years.

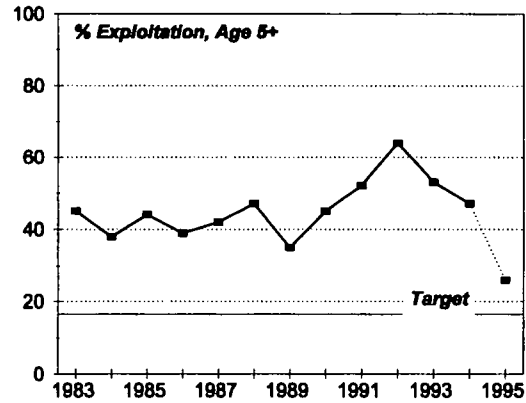


A mobile gear survey (**ITQ survey**) was conducted by the ITQ fleet in 4X in 1995, concurrent with the RV survey. The ITQ survey covered most of the 4X area, including much of the inshore area which is not covered by the RV survey. The pattern of cod catches in the ITQ survey was similar to those from the RV survey, and these catches extended into the inshore areas. The development of an ITQ survey series will allow us to evaluate whether the proportion of cod residing outside the RV survey area in 4X is consistent over time.

Commercial catch rates for both longline and otter trawl fisheries (tonnage classes 2 and 3) were not used to estimate stock abundance due to changes in fishing practices, such as introduction of individual quotas, trip limits, changes in mesh type and size, and changes in hook size.

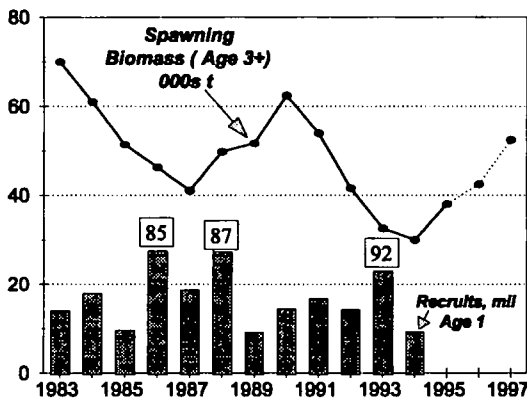
Population abundance estimates indicate that the stock is showing a slight increase in 1995 after declining rapidly from a peak in 1990 to the lowest level in the time series in 1994. This decline occurred as the strong 1985 and 1987 year-classes were being fished down. Assuming that the 9,000t TAC in 1995 is caught, the beginning of 1996 age 3+ biomass of 42,000t will remain below the 1983-1995 average, although it will be well above the low of 29,000t seen in 1994.

94. The exploitation rate has consistently been well over twice the target of 16%, reaching a high of 64% in 1992 and declining to 47% in 1994.



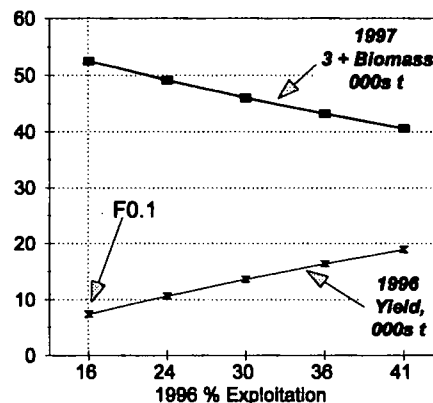
Outlook

The expected catch of about 9,000t in 1995 will result in an exploitation rate of 26%, approaching the target exploitation rate of 16%. The projected yield at the target exploitation rate for 1996 would be about 7,400t, 43% of which is expected to come from the 1992 year-class. Assuming that the $F_{0.1}$ fishing rate can be achieved, the spawning stock biomass is projected to increase by 10,000t in 1996 to about 52,000t at the beginning of 1997 to surpass the 1983-95 average of 49,000t.



Inclusion of the 1995 survey data has little impact on the perception of past **recruitment** patterns, except for the 1992 year-class which now appears stronger than initially estimated from the 1994 survey. The initial indication given by the 1995 survey is that the 1993 year-class is well below average.

The inclusion of the survey and the first half year catches for 1995 did not change the perception of exploitation rate trends for 1983-



The 1992 year-class is expected to provide much of the increase in spawning stock biomass over the next two years, as the 1993 year-class appears to be quite weak.

For More Information

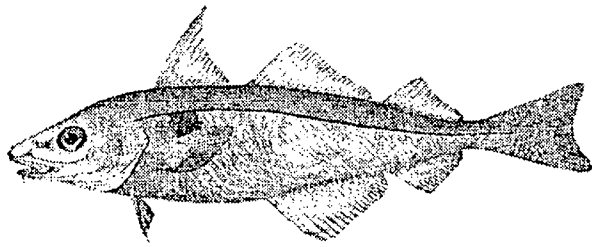
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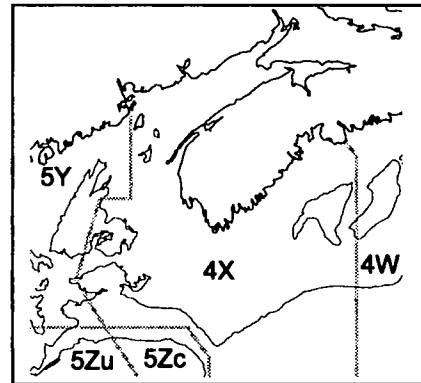
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SOUTHERN SCOTIAN SHELF AND BAY OF FUNDY HADDOCK



Background

Haddock are found on both sides of the North Atlantic. In the west Atlantic, they occur from southwest Greenland to Cape Hatteras. A major stock exists in the southern Scotian Shelf and Bay of Fundy area. This bottom-dwelling species is a member of the cod family and feeds mainly on small invertebrates. It is most common at depths ranging from 25-75 fathoms and in bottom temperatures above 2°C. Although seasonal migrations are evident within the stock area, there is relatively little exchange between adjacent haddock stocks.

Young haddock in this stock are relatively fast growing, reaching 17 inches and 1.7 pounds by age 3 on average. Growth slows thereafter and haddock reach only about 26 inches in length by age 10. Haddock in the Bay of Fundy grow more rapidly than those on the southern Scotian Shelf. Approximately 50% of female haddock are mature by age 3; however the number of eggs produced by a female of this age is low and increases dramatically with age. Browns Bank is the major spawning area for the stock and peak spawning may occur from April to June.

Reported annual landings have been as high as 36,000t and the long-term average is about 20,000t. Landings have been below 11,000t since 1988. While this fishery has been dominated by mobile gear historically, the proportion of landings taken by fixed gear has increased in recent years and has been greater than 50% since 1990. Quotas for this stock were introduced in 1970 and a spawning season/area closure has been in place since that time.

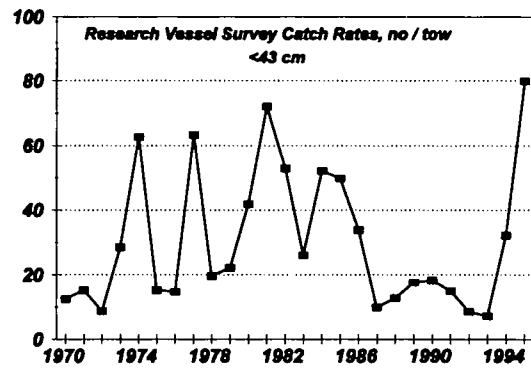
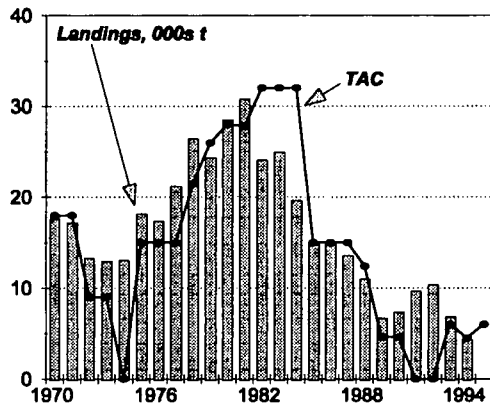
The Fishery

Landings (thousands of tonnes)

Year	70-79 Avg.	80-89 Avg.	1990	1991	1992	1993	1994	1995
TAC	14.7	21.4	<4.6 ¹	- ¹	- ¹	6.0	4.5	6.0
Total	18.2	18.9	7.3	9.7	10.4	6.8	4.3	3.5 ²

¹ - By-catch only
² - as of 15 September 1995

Reported landings of 4X haddock in the first and second quarters of 1995 were 1,431t and 875t, respectively, relative to 822t and 1,168t in 1994. The increase in first quarter landings occurred primarily in the mobile gear sector. During industry consultations, it was indicated that this increase was due to vessels directing for haddock as a result of favourable haddock prices early in the year. First quarter landings in the fixed gear sector decreased slightly relative to 1994, due to extensive closures. Second quarter landings decreased in both gear sectors, as vessels attempted to avoid haddock. In addition, fixed gear vessels were subject to further closures.

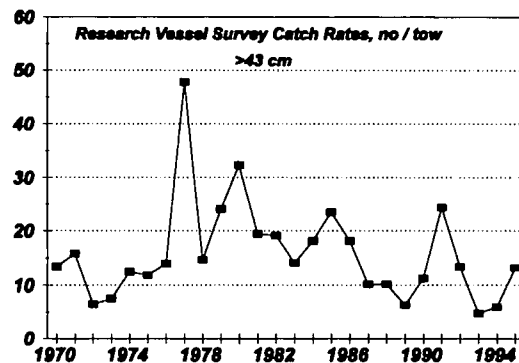


Surveillance reports indicated that discarding of small haddock occurred in the longline fleet in January, while vessels were fishing under an interim Management Plan. When the longline fishery was re-opened in April, catches of small haddock were reported from LaHave, Roseway, and Baccaro banks. These banks were closed to the longline fleet on 30 June 1995 and subsequent test fisheries have indicated continued catches of small haddock. Catches of small haddock in the mobile gear fishery were not reported to be widespread.

Resource Status

Abundance in the research vessel survey increased from a historic low level in 1993 to more than twice the long term mean in 1995, the second highest value observed in the survey series; however, this increase was mainly due to record numbers of small haddock (less than 43cm). The catch of haddock at modal lengths of 18 and 30cm, respectively, (aged 1 and 2 years old) was much larger than average. This is consistent with the result of the 1994 survey, when these haddock were aged 0 and 1 years old.

The 1995 survey indicated that the abundance of market size haddock (greater than 43cm) has increased. Catches of haddock in the length range of 38 to 48 cm (which would include the 1992 year-class) were at or slightly above average, consistent with the 1993 survey estimate of this year-class but more optimistic than the 1994 survey result. The latter had indicated that the 1992 year-class was below average in abundance. Catches in the length range of 50 to 58cm were slightly higher than last year but still lower than average, while catches in the length range 60 to 70cm were comparable to last year and still below average.



Haddock were more widely distributed in the 1995 survey than in recent years, with the pattern being comparable with periods of higher abundance. Haddock were encountered in the eastern portion of the survey area and in the

upper part of the Bay of Fundy, where they had not been encountered in recent years. Abundance increased throughout the survey area, but the increase in the eastern and central portions of the survey consisted primarily of small haddock. The increase in the Bay of Fundy, however, consisted of both small and market sized haddock.

Preliminary results from the **ITQ survey** conducted in summer 1995 in cooperation with DFO Science, were examined. The size composition of haddock caught by this survey and by the research vessel survey in four traditional DFO research survey strata were quite comparable. Furthermore, the size composition of haddock caught in the area not covered by the research vessel survey were also comparable, with large catches of haddock in the size range of haddock aged 1 and 2 years old.

Population abundance in 1995 predicted by the spring assessment is lower than indicated by the 1995 summer research vessel survey. Accordingly, the exploitation rate indicated by the spring assessment is higher than would be expected from an analysis incorporating the 1995 research survey results.

Outlook

During the period 1983-1991, **recruitment** has been below average. The 1995 survey supports the results of the previous two surveys and indicates that the 1992 year-class is average in size and the 1993 and 1994 year-classes are above average. This is further supported by preliminary results of the ITQ survey and by anecdotal reports of catches of small haddock by the longline fleet, particularly on the offshore banks. The distribution of haddock in the 1995 survey is more widespread, which may also be indicative of increasing abundance,

particularly at the younger ages. The 1995 research vessel survey also indicates that the abundance of market size haddock has increased. There are concerns regarding possible changes in availability of haddock to the survey gear, but these remain to be addressed.

There are uncertainties concerning the exact level of spawning stock biomass and fishing mortality, in part due to problems with the ageing data for this stock in recent years. However, significant progress has been made in resolving these problems. While there are still concerns that spawning biomass may be low and fishing mortality above $F_{0.1}$, biomass appears to be increasing due to incoming average to above average 1992, 1993, and 1994 year-classes. Based on a qualitative evaluation of the available information, indications are that a catch of 6000t in 1996 would not result in a decrease of the total or spawning biomass. Furthermore, it was stressed that the use of strict small fish protocols and area and season closures should be continued to allow these recruiting year-classes to become mature and reproduce.

For More Information

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