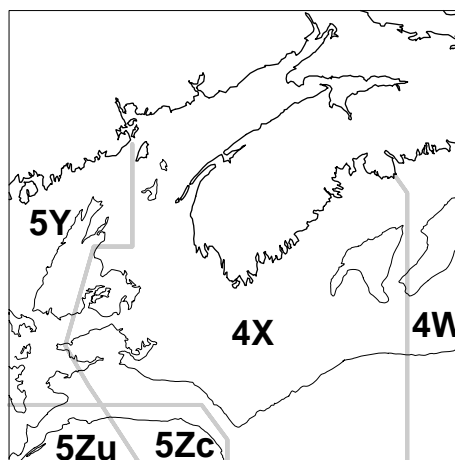




SOUTHERN SCOTIAN SHELF AND BAY OF FUNDY HADDOCK



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 (46-137 m) 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 (43 cm) and 1.7 pounds (0.8 kg) by age 3 on average. Growth slows thereafter and haddock reach only about 26 inches (66 cm) 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.

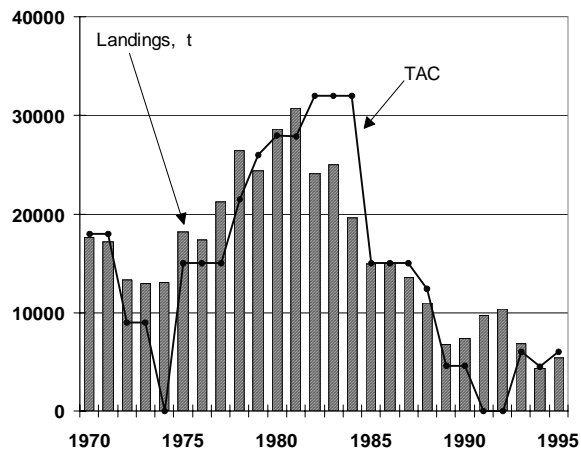
The Fishery

Landings (thousands of tonnes)

Year	70-79 Avg.	80-89 Avg.	1991	1992	1993	1994	1995
TAC	14.7	21.4	¹	¹	6.0	4.5	6.0
TOTAL	18.2	18.9	9.7	10.4	6.8	4.3	5.4

¹ - By-catch only

Reported landings of 4X haddock in 1995 were 5,416t, relative to a TAC of 6,000t. This shortfall occurred primarily in the fixed gear sectors and can be attributed to extremely restrictive fishing plans. In many cases, the shortfall in haddock occurred because cod allocations were taken first. The 1996 TAC is 6,500t.



Surveillance reports from the longline fleet indicated that discarding of small haddock occurred in January, while vessels were fishing under an interim management plan. This led to the closure of the fishery in February. 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 indicated continued catches of small haddock. These areas remained closed throughout the remainder of the year.

From **surveillance reports**, the mobile gear sectors continued to avoid haddock by directing for other species (flatfish, redfish, shrimp, silver hake). By-catches of small haddock by the mobile gear fleet were not a major issue.

A comparison of the **size composition of commercial catches** of 4X haddock over time showed that there has been a steady increase in the average length of mobile gear landings since the introduction of square mesh gear and ITQs in 1990/91. Over the period 1990-1993, however there was a decrease in the average length in the fixed

gear landings. Average length in the fixed gear landings has remained relatively steady since but was still smaller than that in the mobile gear landings (50.5 vs 54.7cm respectively in 1995). The overall size composition of landings in 1995 was comparable to the long term average, but there was a decrease in average length in 1995 relative to 1994.

Consultations with industry indicated that 1995 landings data for 4X haddock were reasonably accurate. Discarding and highgrading were acknowledged as being present in 1995, particularly in the longline fleet, but the amount could not be quantified. There did not appear to have been a major change in discarding practices since 1994. Nevertheless, landings will underestimate removals from the population.

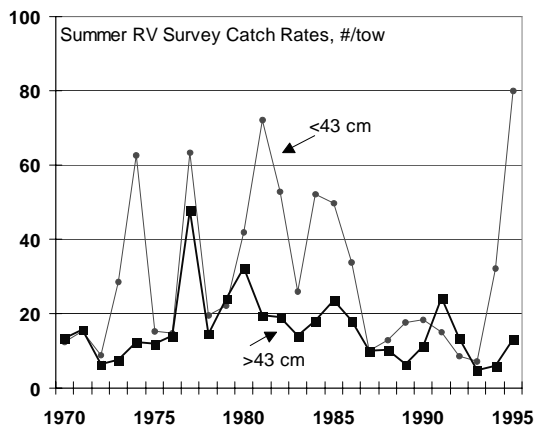
Resource Status

The stock status evaluation was based on an assessment using landing statistics, sampling of age and size composition of the commercial catches, trends in abundance from the summer research vessel surveys, and the results of a joint resource survey conducted in 1995 by industry in cooperation with DFO Science.

Preliminary **ageing data** are available for otoliths collected during the summer research vessel surveys from 1987 to present. Comparisons of research vessel numbers at age based on the new ageing data and those based on the earlier ageing data showed large differences, with the new ageing data resulting in much higher proportions of older fish in the population. As revised ageing data were not yet available for samples of the commercial catches during this period, the research vessel ageing data were used, together with the size composition of the

commercial catches, to estimate the age composition of the commercial catches.

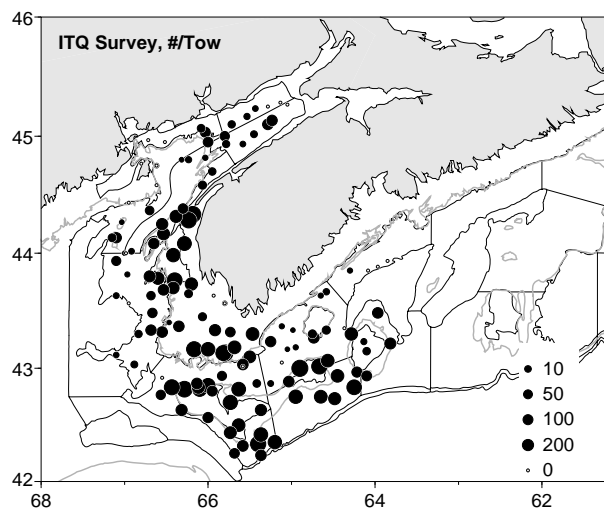
Abundance in the **summer research vessel survey** increased from an historic low level in 1993 to more than twice the long term average in 1995, the second highest value in the survey series. This increase was due mainly to record numbers of small haddock (less than 43cm). Catches of haddock at ages one and two years old (1993 and 1994 year-classes) were widespread throughout the stock area and were much larger than average, as was the case in the 1994 survey, when these same year-classes were aged 0 and 1 years old. The 1995 survey indicated that the abundance of market-size haddock (greater than 43cm) has increased only slightly, and only in the Bay of Fundy portion of the stock area.



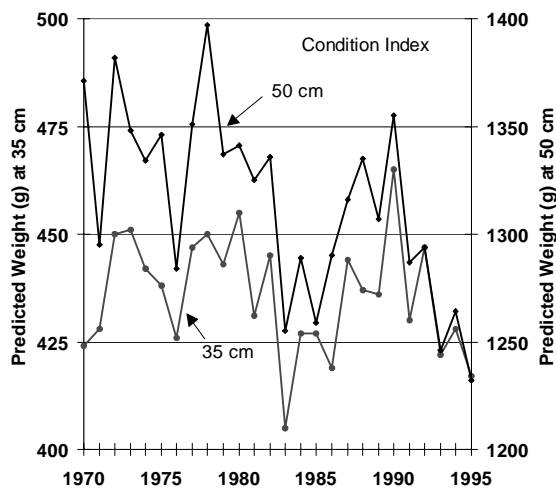
Haddock were more widely distributed in the 1995 research vessel survey than in recent years. Haddock were encountered in the eastern portion of the stock area and in the upper part of the Bay of Fundy, where they had not been encountered in recent years. Abundance increased throughout the survey area, but the increase in the eastern and central portions of the stock area consisted primarily of small haddock. The increase in

the Bay of Fundy however, consisted of both small and market-size haddock.

A **joint industry/DFO Science resource survey** of 4X was conducted in summer 1995 by the ITQ fleet. A total of 139 standardized fishing sets were made by three vessels during the same time period that the research vessel survey was conducted. While this survey did not sample the entire stock area, 27 sets were made inshore of the traditional research vessel survey strata, in an area where a substantial portion of the mobile gear fishery occurs. Results of the ITQ fleet survey were generally comparable to the research vessel survey results, with widespread catches of haddock, particularly at lengths corresponding to ages 1 and 2. The length composition of the ITQ fleet survey sets and research vessel survey sets in strata adjacent to the inshore area were similar. A comparison of the length composition of sets in the inshore area and in the adjacent strata showed the same modes but in different proportions; however we are unable to determine the implication of these differences until further surveys are conducted.



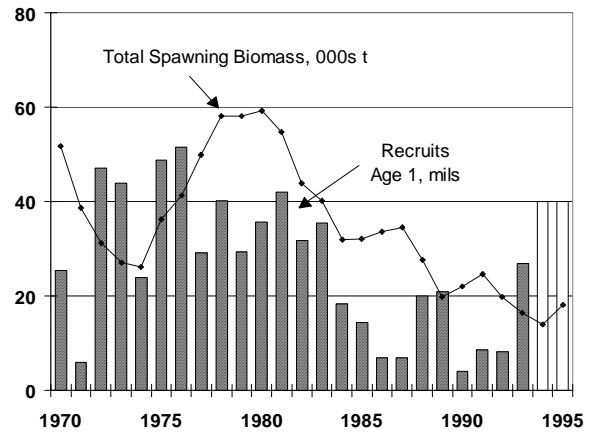
Condition is the relative weight of the fish for their length i.e. their plumpness. An index of condition was developed based on the length/weight relationship derived from the annual summer research vessel surveys. This index was variable, but indicated that condition has decreased since the late 1980s to low levels in 1995. Low condition may be an indicator of stress; however the cause and significance of low condition in this case is uncertain.



Studies have indicated that past assessments of this resource have underestimated exploitation and overestimated population abundance in the current year, particularly when large year-classes occur. This pattern is still evident in the present analysis, and adds uncertainty to the results of this assessment.

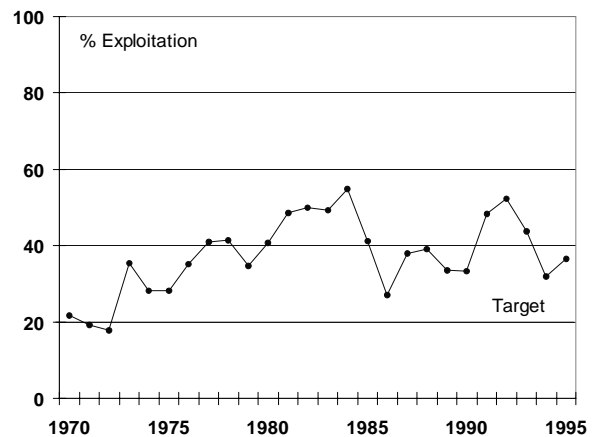
Except for the 1987 and 1988 year-classes, recruitment of the year-classes 1983-91, was below average; however the 1992 year-class is estimated to be of average strength. Although the estimate of the 1993 year-class is still uncertain, it is indicated to be well above average in strength. The 1994 and 1995 research vessel surveys suggest that the 1994 year-class is also well above average in strength.

Spawning stock biomass has been decreasing since 1980 and reached a low of 14,000t in 1994. It is estimated that spawning stock biomass increased in 1995 to 18,000t, as the 1992 year-class began to mature.



* 1994 and 1995 age 1 recruits assumed

The **exploitation rate** on ages 5-7 has been higher than the target since the early 1970s. Exploitation decreased from approximately 50% in 1991-92 to about 30% in 1994 and increased slightly to 36% in 1995.

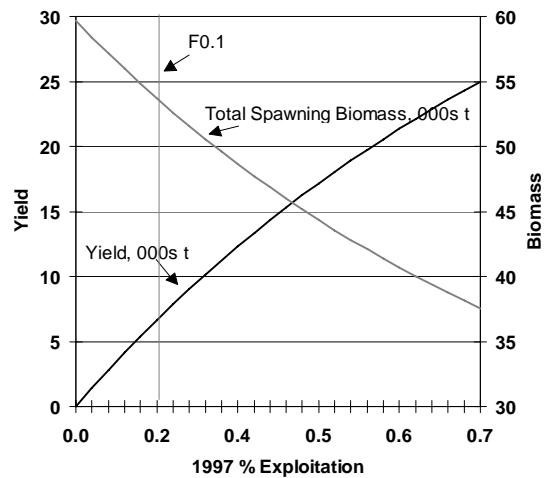


Oceanographic conditions in 1995 were examined and, unlike on the eastern Scotian Shelf, no conditions were identified that would adversely affect the distribution of haddock in 4X. Although cooler conditions occurred on Roseway and eastern Browns

Banks and on Lurcher Shoal, these were still above temperatures that haddock avoid.

Outlook

This analysis indicates that landings of 4X haddock of 6,500t in 1996 would result in an exploitation rate of approximately 30%. Using an estimate of age one recruitment of 40 million for the 1993 and 1994 year-classes, the **projected yield** at the target exploitation rate (20%, $F_{0.1}=0.25$) in 1997 would be about 6,700t. Spawning stock biomass would increase to 54,000t by the end of 1997, but this projection is very dependent upon the estimated strength of these year-classes. It is encouraging that the 1994 and 1995 research vessel surveys suggest the 1993 and 1994 year-classes are strong. The July 1996 research vessel survey will reduce the uncertainty of the strength of these year-classes. The abundance of small fish on the banks will be high and use of strict small fish protocols and area and season closures should be continued to allow these recruiting year-classes to realize their growth and reproductive potential. Continuing conservation efforts such as low exploitation are also needed to rebuild population biomass and to expand the age structure in the population.



For More Information

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References

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