

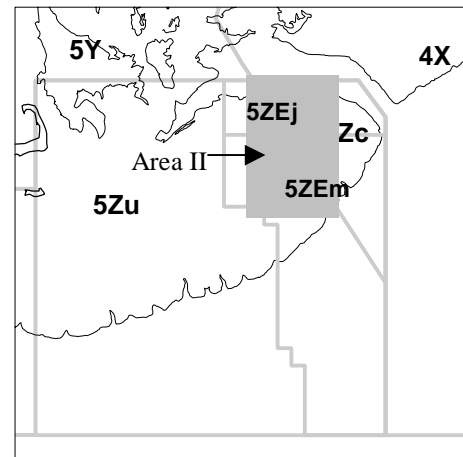
Eastern Georges Bank Cod

Background

The cod fishery on Georges Bank has been in operation since the late 1700s. Since 1977, only Canada and the USA have had directed fisheries and, with the establishment of the Canada/USA boundary in 1985, each country has been limited to their respective sides. Canadian catches of cod are taken primarily between June and October. Management of the Canadian fishery has been by seasonal closures to all gears and by EA's for vessels >65', ITQ for <65' mobile gear since June 1992 and by individual or community quotas for fixed gear. The USA fishery in the management area has been constrained by spatial expansion of closed Area II in 1994 and by extension to year-round closure in 1995.

In recent years, most of the biomass has been found on the Canadian side of the international boundary, although substantial seasonal movements relative to the boundary occur.

Georges Bank cod prey heavily on fish, but crustaceans and molluscs are also included in their diet. Cod in this area have a very fast growth rate, reach 50 cm (20 in) and begin to spawn for the first time by age 2, and by age 3 almost all are sexually mature.



Summary

- Canada and USA catches in 1999 were 3,000t, a 10% increase over 1998.
- Growth and higher survival of year-classes were the primary sources of increased adult 3+ biomass from 8,000t in 1995 to about 18,200t in 2000.
- Recruitment has been below the 1978-98 average of 7.5 million since the 1990 year-class. Recruitment has been observed to be low when adult biomass is less than 25,000t but it is unlikely that an adult biomass of 25,000t can be achieved in the short term.
- Exploitation rate on ages 4+ declined from 65% in 1993 to near the $F_{0.1}$ level in 1995 and remained near $F_{0.1}$ in 1996-99. However, exploitation of age 3 cod (the 1996 year-class) was the highest observed on that age group since 1995.
- Other biological and fishery attributes include: a modest trend for lower weight at age at some older ages, an increase in the proportion mature at age 2 in the late 1990's despite an increase in biomass, consistent spatial and seasonal distribution, improved survival to ages 5+, reports of relatively good catch rates by fishers and excessive cod bycatch in haddock-directed trips.

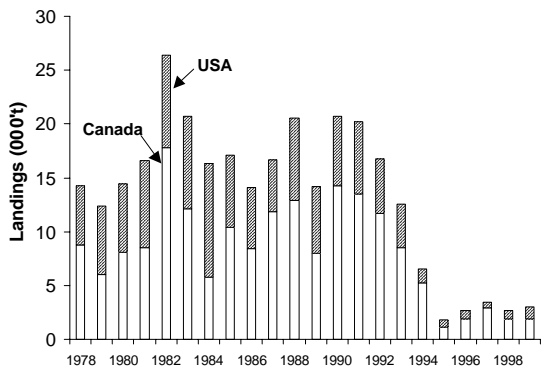
- Yield projection at $F_{0.1}$ for 2000 indicates a **combined** Canada/USA yield of about 3,750t. At the $F_{0.1}$ yield, **adult biomass will decrease** by about 10% at the beginning of 2001. A stable biomass will occur with a 2000 yield of about 1,500t but even with no catch in 2000 the 2001 biomass will only increase by about 5%.

The Fishery

Catches (thousands of tonnes)

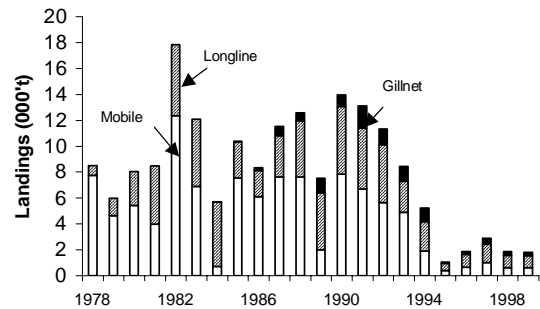
Year	1978-90 Avg.	1991-95 Avg.	1996	1997	1998	1999
Cdn. Quota	-	13.2	2.0	3.0	1.9	1.8
Canada	10.2	8.0	1.9	2.9	1.9	1.8
USA	7.0	3.6	0.8	0.6	0.8	1.2
TOTAL	17.2	11.6	2.7	3.5	2.7	3.0

Combined Canada/USA catches peaked at 26,000t in 1982, averaged about 17,900t between 1978-92 and declined to 1,800t in 1995, the lowest observed. Landings since 1996 have been about 3,000t. Canada has accounted for over 65% of the total 5Zej and 5Zem landings.



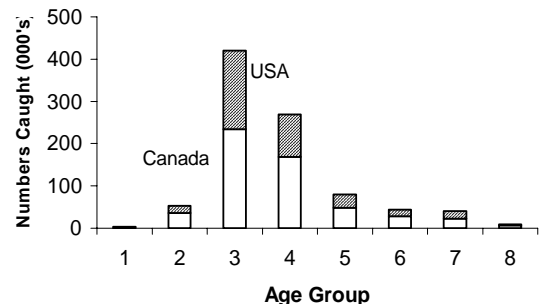
Canadian catches are now dominated by landings from fixed gear components. Since 1994 and with reduction in allowable yields, the Georges Bank fishery has become more of a mixed species fishery with reduced targeting for cod and in 1995 fishing was restricted to bycatch only. Since 1995, industry also imposed self-regulation to avoid overrunning allocations, including directing for haddock in early June and late fall when

cod bycatch was low. In 1999, most gear sectors reached their allocation, a high proportion of trips included observers and landings were subject to 100% dockside monitoring. Management measures were introduced in 1999 which allowed smaller scale geographic monitoring of cod/haddock catch ratios and potential closure of subareas with high ratios. The Canadian groundfish fishery in 5Zj,m was closed to all vessels from 1 January to mid-June 1999.



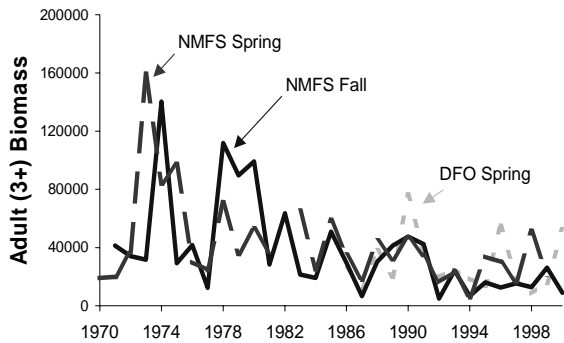
USA catches for 1995-98 ranged from 557t to 795t. In 1995, the USA imposed a year-round closed area (Area II) in part of the 5Zej and 5Zem area and also increased minimum mesh sizes in 1994 and again in 1999. Limits on sea days were also used as an additional measure for effort reduction. USA catches increased from 795t in 1998 to 1,150t in 1999.

The 1995 and 1996 year-classes dominated the 1999 fishery and comprised over 70% of the total catch in numbers. Contribution from the 1996 year-class was higher than expected from the yield projection of 1999.

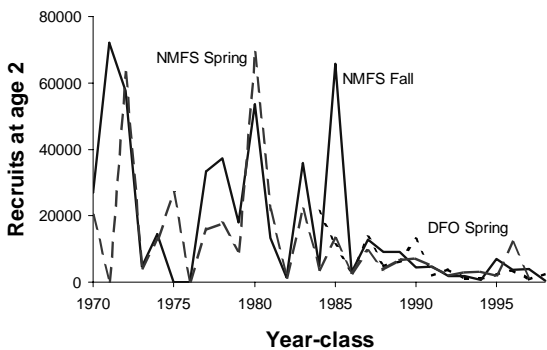


Resource Status

All three surveys appear to demonstrate similar trends with a consistent spatial distribution by season. Adult (3+) biomass declined between 1990-92 and showed some modest recovery since 1995. The 2000 DFO spring survey shows a substantial increase over 1999 but most of the increase was attributed to one very large catch. This set was included in the analysis. The most recent NMFS spring and fall surveys show a biomass decrease in the last year.

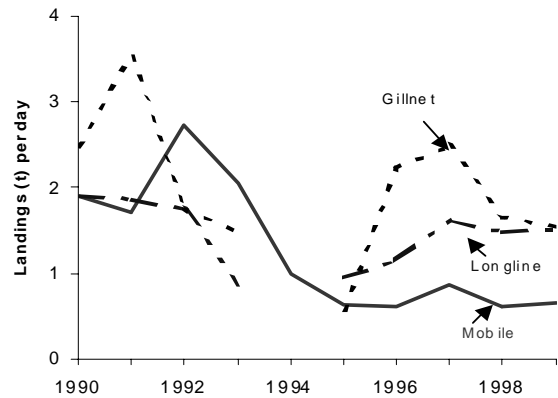


The age two recruitment index has been well below the long-term average since the 1990 year-class and the 1997-1999 year-classes appear to be very low. The 1995 and 1996 year-classes were the highest since 1990.

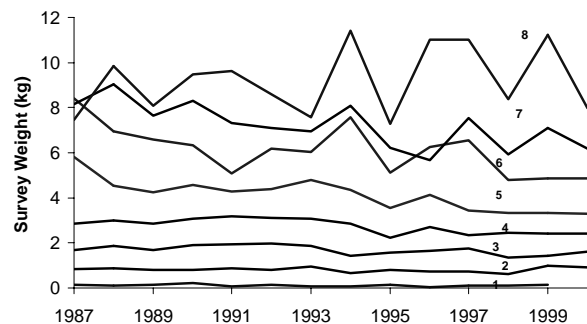


Commercial fishery catch rate (CPUE) for longline, mobile gear and gillnets decreased between 1997 and 1998 and was stable between 1998 and 1999. However, fishers indicated that their recent catch rates are not reflective of cod abundance because of

management restrictions and therefore CPUE is not used in the assessment.



The DFO spring survey **weight-at-age** was used to calculate population biomass at the beginning of the year, while fishery weight-at-age was used to forecast fishery yield. Survey weights-at-ages 4 and younger shows no trend but a modest trend of lower weight-at-age for some older ages is evident.

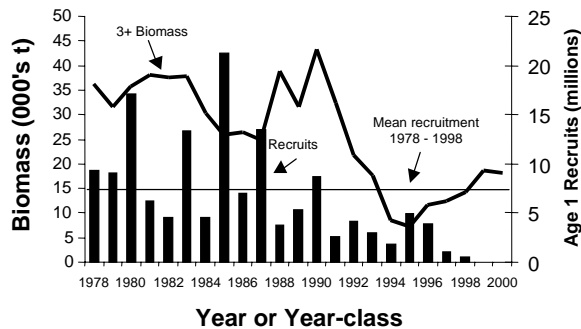


There has been an increase in the **proportion mature** at age two in the late 1990's, despite an increase in biomass in the same time period.

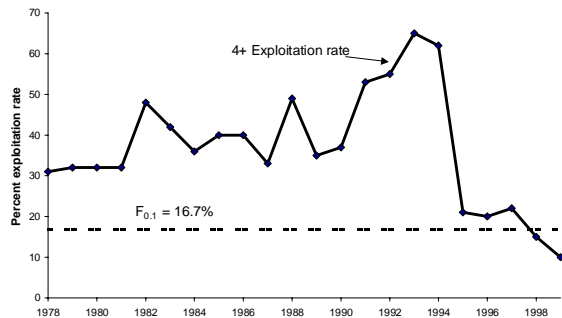
Stock status evaluations were based on an assessment using landings statistics, age composition of the commercial catch and trends in abundance from three bottom trawl research surveys. The NMFS fall survey is lagged by one year for comparison of indices (ie. fall 1977 age one vs. spring 1978 age two) with the NMFS and DFO spring surveys.

There has been a substantial decline in **adult biomass** from about 43,000t in 1990 to about 8,000t in 1995, the lowest observed. The biomass has increased since 1995 to about 18,600t in 1999. However, almost all of this increase has been the result of growth and higher survival to ages 5+ of the 1992 and 1995 year-classes. The 2000 biomass for ages 3+ is about 18,200t.

Recruitment has been below the 1978-98 average of 7.5 million since the 1990 year-class. The 1995 and 1996 year-classes appear to be similar in size to the 1992 year-class with the 1996 year-class somewhat stronger than previous estimates.

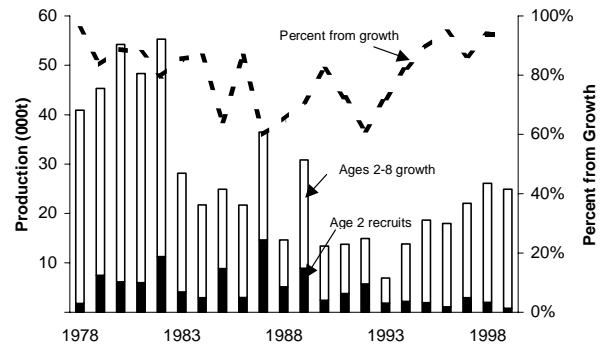


The **exploitation rate for ages 4+** increased rapidly between 1989 and 1993 to 65%, three and a half times the $F_{0.1}$ reference level. In 1995, it declined to near the $F_{0.1}$ level, and has remained near $F_{0.1}$ since 1995. The 1998 and 1999 exploitation rates were less than $F_{0.1}$.



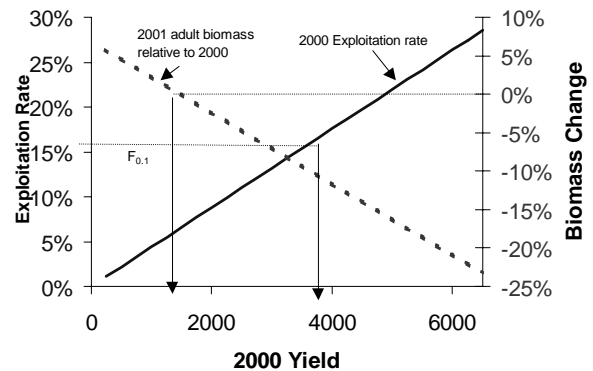
Over the long term, most (60-90%) of the cod stock **production** has been derived from growth of ages 2-8 with the rest coming from

recruitment. In recent years, due to weak recruitment, the amount due to growth has increased and now is over 90% of the total.



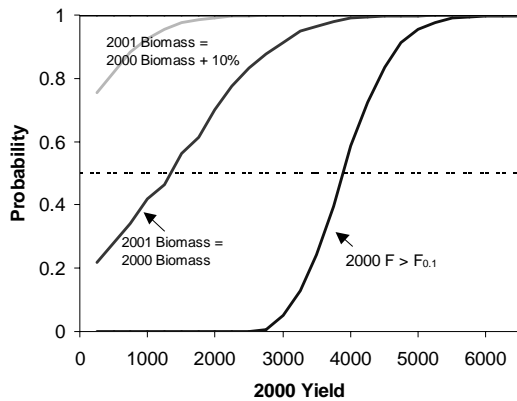
Outlook

Yield projection at $F_{0.1}$ for 2000 indicates a **combined** Canada/USA yield of about 3,750t. At the $F_{0.1}$ yield, **adult biomass will decrease** by about 10% at the beginning of 2001. A stable biomass will occur with a 2000 yield of about 1,500t but even with no catch in 2000 the 2001 biomass only increases by about 5%.



Uncertainty associated with results of the assessment can be related to the probability that the exploitation rate in 2000 will exceed the $F_{0.1}$ reference or that the 2001 biomass will be less than the 2000 biomass. These calculations do not include uncertainty due to variations in weight at age, partial recruitment, variations in natural mortality, systematic errors in data reporting or model mis-specifications.

At a combined 2000 Canada/USA yield of about 3,000t, the same as the 1999 yield, there is a low probability of exceeding $F_{0.1}$ but more than 90% probability of a decrease in adult biomass. At a 2000 yield of 1,500t the probability of a decrease in adult biomass is about 50%.



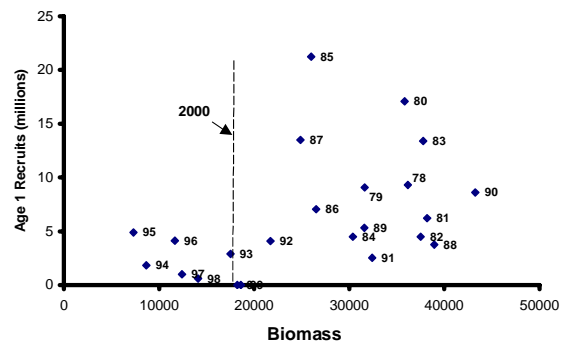
Management Considerations

The 1999 yield projections indicated that a catch of 2,800t would result in an exploitation rate of less than $F_{0.1}$ and almost no increase in biomass. The actual 1999 landings of 2,900t resulted in an exploitation rate of 10% but the adult biomass decreased from 18,600 t in 1999 to 18,200 t in 2000.

Comparison of adult biomass and resultant recruitment indicates that the relatively small post-1992 year-classes have been produced at biomass levels of 25,000t or less. The chance of **poor recruitment** (less than 5 million) is higher when the adult biomass is less than a 25,000t threshold.

It is projected that over 50% by weight of the 2000 yield at $F_{0.1}$ would be comprised of the 1995 and 1996 year-classes. Enhancing survivorship of these year-classes would benefit stock rebuilding. However, fishing mortality on the 1996 year-class at age 3 in 1999 was higher than that observed on this age group since 1995. Subsequent poor recruitment will lead to reduced prospects

for an increase in biomass towards a 25,000t threshold.



An analysis of 1992-1996 **biomass distribution** relative to the **international boundary** from research surveys shows a seasonal pattern. Virtually all cod of ages 2 and older were found on the Canadian side during the NMFS fall survey, while the proportion found during the DFO and NMFS spring surveys ranged between 40% and 85%.

Cod and haddock are often caught together in groundfish fisheries. However, their **catchabilities** to the fisheries differ and they are not necessarily caught in proportion to their relative abundance. Exploitation of haddock at $F_{0.1}$ levels with current fishing practices may compromise the achievement of rebuilding objectives for this cod stock.

References

- Hunt, J.J. and B. Hatt. 2000. Status of Eastern Georges Bank cod (Unit Areas 5Zej, 5Zem) for 1978-2000. DFO Can. Stock Assess. Secretariat Res. Doc. 2000/085.

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