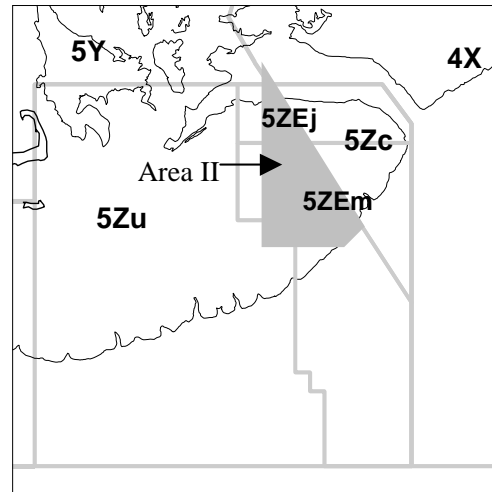


Eastern Georges Bank Cod



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 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

- Combined Canada and USA catches in 1998 were 2,700t.
- Growth and higher survival of the 1992 and the 1995 year-classes were the primary source which increased adult biomass from 8,000t in 1995 to about 19,000t in 1999.
- Recruitment has been below average since the 1990 year-class, and the 1997-98 year-classes are the lowest observed. Recruitment has been observed to be low when adult biomass is less than 25,000t.
- The likelihood of a 20% increase in biomass, as observed in 1998, is low due to this recent poor recruitment. It is unlikely that an adult biomass of 25,000t can be achieved in the near future.
- 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 1996-98.
- At the projected 1999 $F_{0.1}$ yield of 3,700t there is over a 50% probability that the biomass will decrease in 2000. To achieve a 50% probability of a modest (10%) biomass increase would require a 1999 quota of about half the 1998 catch.

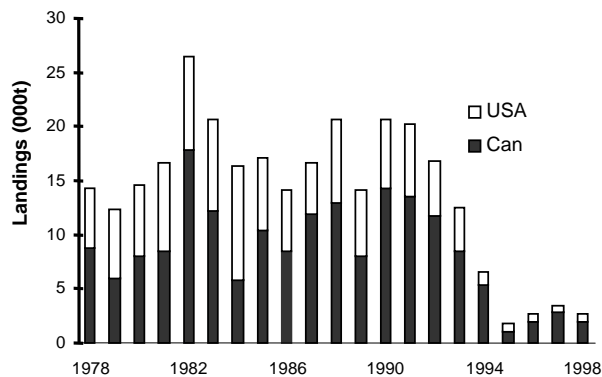
The Fishery

Catches (thousands of tonnes)

Year	1978-89	1990-94	1995	1996	1997	1998
	Avg.	Avg.				
Cdn. Quota	-	13.2	1.0*	2.0	3.0	1.9
Canada	9.9	10.6	1.1	1.9	2.9	1.9
USA	7.1	4.7	0.7	0.8	0.6	0.8
TOTAL	17.0	15.3	1.8	2.7	3.5	2.7

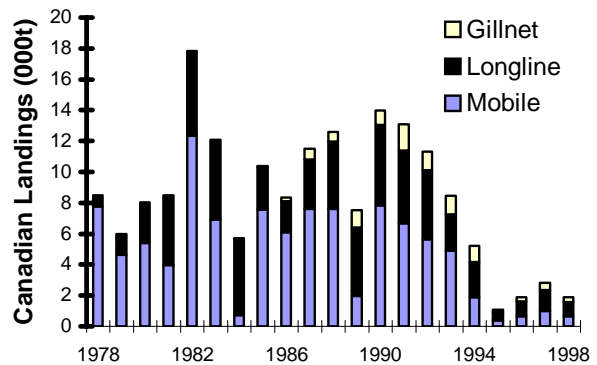
* No directed fishery, bycatch limit

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 increased to about 2,700t in 1996, to 3,500t in 1997 and decreased to 2,700t in 1998. In 1985-94, Canada accounted for 66% of the total 5Zj,m landings and about 72% in 1995-98.



Canadian catches had been dominated by otter trawlers, except in 1984 and 1989, but the proportion of total landings taken by fixed gears (longline and gillnet) has increased in recent years, and the longline fishery now dominates. Since 1994, the Georges Bank fishery has become more of a mixed species fishery with reduced targeting for cod and in 1995 cod was taken as bycatch only. In 1998, most gear sectors reached their allocation. A high proportion of trips included observers and landings were subject to 100% dockside monitoring. All vessels fishing in less than 90 fm were required to have an observer during part of the fishing season.

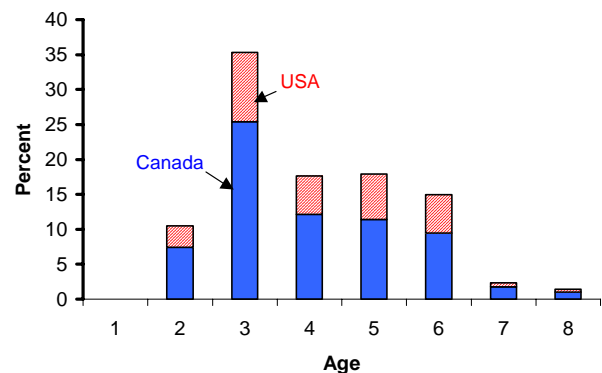
Industry also imposed self-regulation to avoid overrunning allocations, including directing



for haddock in early June and late fall when cod bycatch was low. Discarding in the 1998 fishery may have occurred in early June prior to increased observer coverage. The Canadian groundfish fishery in 5Zj,m was closed to all vessels from 1 January to early June 1998.

USA catches for 1995-98 ranged from 557t to 795t. Beginning in 1995, the USA imposed a year-round closed area in part of the 5Zj,m area and also increased minimum mesh sizes. Limits on days at sea were used as an additional measure for effort reduction.

In 1998, the 1995 year-class comprised 37% of the total catch in numbers.

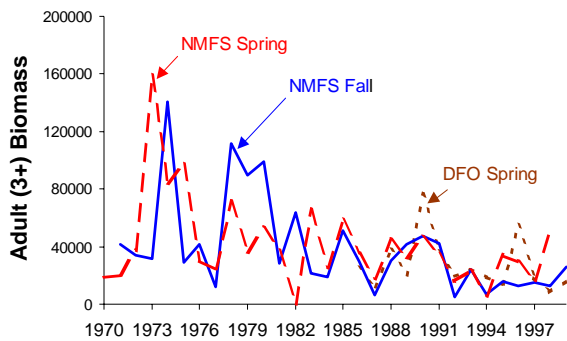


Resource Status

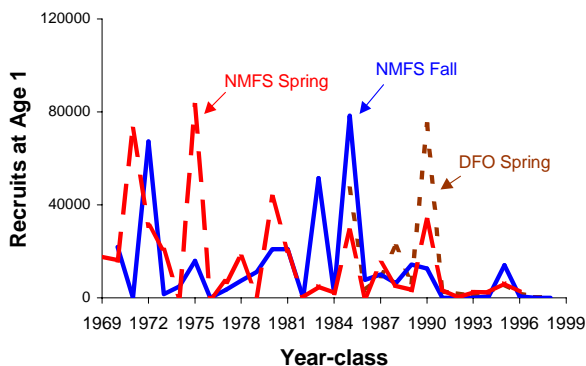
Stock status evaluations were based on an assessment using landings statistics, age

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.

All three surveys appear to demonstrate similar trends with biomass declining between 1990-92 and remaining at low levels since 1992. The 1999 DFO spring and the two 1998 NMFS surveys show an increase in biomass over 1997 which remains low.

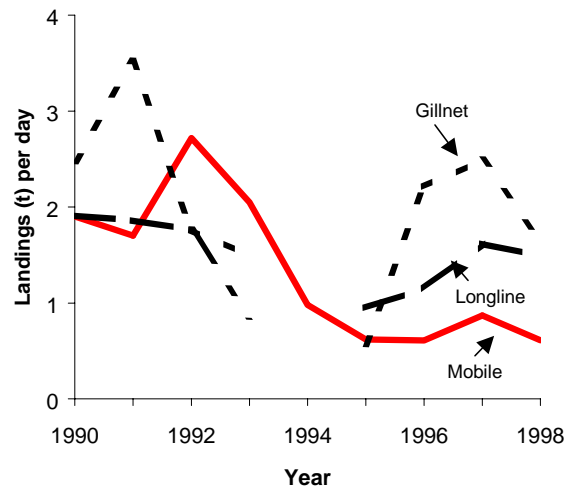


The age one recruitment index has been below average since the 1990 year-class and the 1997 and 1998 year-classes are the lowest observed.

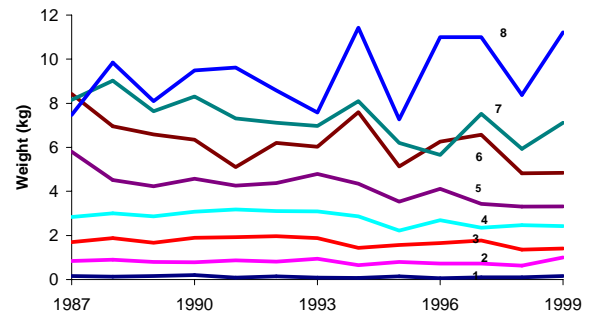


Commercial fishery catch rate (CPUE) for longline mobile gear and gillnets decreased between 1997 and 1998. However, fishers indicated that their recent catch rates are not

reflective of cod abundance because of management restrictions and therefore CPUE is not used in the assessment.



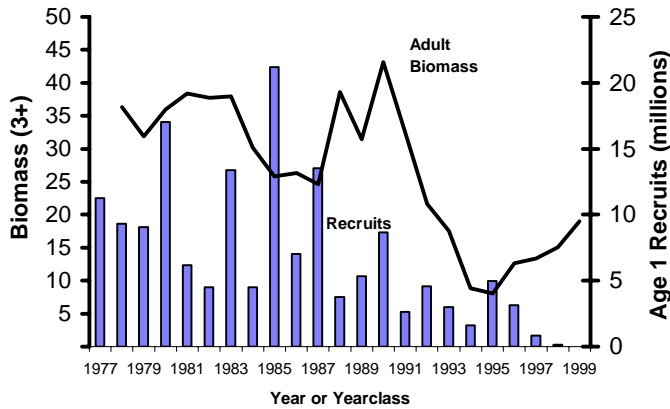
Survey weight-at-age was used to calculate population biomass at the beginning of the year, while fishery weight-at-age was used to forecast fishery yield. The decline in survey weight-at-age between 1997 and 1998 was reversed in 1999 for some ages but the overall trend of lower weight at age remains.



There has been a substantial decline in age 3+ biomass from 42,000t in 1990 to less than 10,000t in 1995, the lowest observed. The 3+ biomass has increased since 1995 to about 19,160t in 1999. However, almost all of this increase has been the result of growth and higher survival of the 1992 and 1995 year-classes.

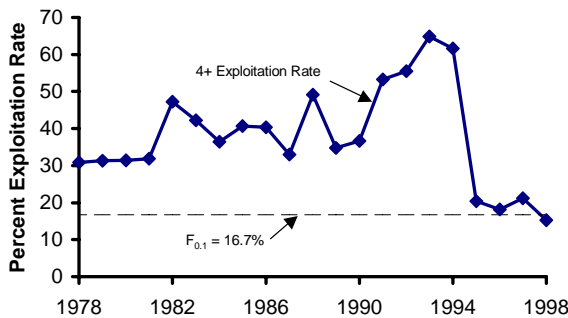
Recruitment has been below average since the 1990 year-class, and the 1997 and 1998

year-classes are the lowest observed. The 1995 year-class appears to be similar in size to the 1992 year-class and the 1996 year-class somewhat stronger than previous estimates.

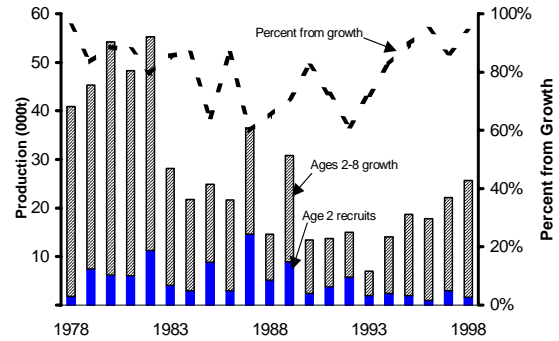


An analysis of fishing patterns during 1995-98 indicated that the fishing mortality on age three cod has been reduced relative to that previously due to recent increases in mesh size and other measures to avoid catching small fish. For this reason, it is now more appropriate to examine age 4+ exploitation as indicative of annual trends in fishing pressure.

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.



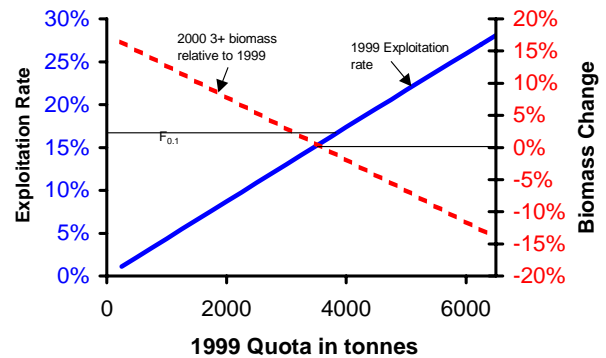
Over the long-term, most (60-90%) of the cod stock **production** has been derived from growth with the rest coming from recruitment.



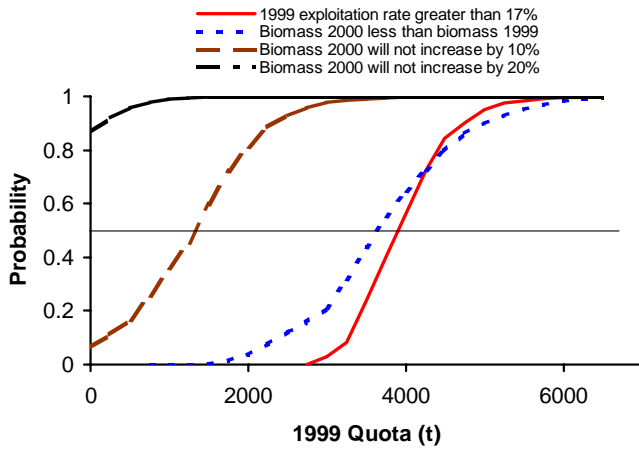
In recent years, due to weak recruitment, the amount due to growth has increased and now is over 90% of the total.

Outlook

Yield projection at $F_{0.1}$ for 1999 indicates a **combined** Canada/USA yield of about 3,700t. However, even at the $F_{0.1}$ yield, age 3+ biomass may slightly decrease by the beginning of 2000.



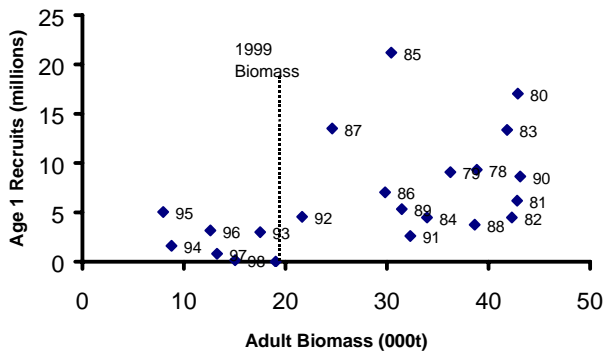
Uncertainty associated with results of the assessment can be related to the probability that the exploitation rate in 1999 will exceed the $F_{0.1}$ reference or that the 2000 biomass will be less than the 1999 biomass. These uncertainty calculations do not include variations in weight at age, partial recruitment, variations in natural mortality, systematic errors in data reporting or model mis-specifications.



At a combined 1999 Canada/USA quota of about 2,700t, the 1998 yield, there is a low probability of exceeding $F_{0.1}$ but also a high probability of not achieving a small (10%) increase in biomass. Only at quotas of about half the 1998 catches does the probability of achieving a 10% increase in biomass become more than 50%.

Management Considerations

The 1998 yield projections indicated that a catch of 2,600 t in 1998 would result in an exploitation rate of less than $F_{0.1}$ and an approximate 20% increase in biomass. The actual 1998 landings of 2,660 t resulted in an exploitation rate of 15% and the age 3+ biomass increased from 15,600 t in 1998 to 19,169 t in 1999, a 23% increase.



Comparison of adult biomass and resultant recruitment indicates that the relatively small 1992-98 year-classes have been

produced at biomass levels of 25,000t or less. The chance of **poor recruitment** is higher when the adult biomass is less than 25,000 t. Also, the ratio of recruitment to the adult biomass that produced it remained stable during 1978 to 1995 but has declined since 1995, indicating that year-class survivorship has declined.

It is projected that 22% by weight and 40% by numbers of the 1999 yield at $F_{0.1}$ would be comprised of the 1995 year-class. Enhancing survivorship of this year-class would benefit stock rebuilding. Subsequent poor recruitment will lead to reduced prospects for an increase in biomass towards a 25,000t threshold.

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. This may compromise the joint achievement of objectives.

References

Hunt, J.J. and T.L. Johnston. 1999. Status of the Georges Bank cod stock in 5Zj,m. DFO Can. Stock Assess. Secretariat Res. Doc. 99/77.

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Internet address: www.dfo-mpo.gc.ca/csas
ISSN: 1480-4913

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Correct citation for this publication:

DFO 1999. Eastern Georges Bank Cod.
DFO Sci. Stock Status Rep A3-04
1999.