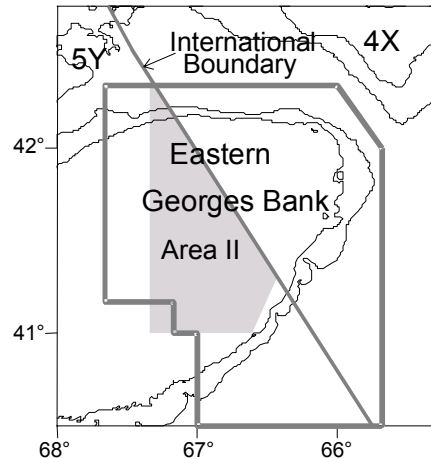




**EASTERN  
GEORGES BANK  
COD**



**Summary**

- Combined Canada and USA catches in 2002 were 2,800 t, a 22% decrease from 2001, due to reduced Canadian catches.
- Adult biomass increased from 8,700 t in 1995 to about 18,500 t in 2001 but has since decreased to about 13,300 t in 2003. Most of the post-1995 increase has been the result of growth and survival to ages 5+ of the 1992, 1995 and 1996 year-classes.
- Lower weights-at-age in the population in 2002-2003 and the continuing low recruitment have contributed to the recent decline.
- Recruitment has been below the 1978-98 average of 7.5 million since the 1990 year-class.
- The fishing mortality for ages 4-6 increased rapidly between 1989 and 1993 to over 0.9. Between 1996 and 2002, fishing mortality ranged between 0.20 and 0.37, greater than  $F_{ref}=0.18$ , and was 0.23 in 2002.
- At a yield in 2004 of 1,300 t, there is about a 20% chance of a decrease in biomass from the beginning of year 2004 to the beginning of year 2005. However, the probability of being below the median 2005 rebuilding biomass of 17,700 t in 2005 is very high.
- With the current poor recruitment and exploitation rates near the present levels, improvement in stock status is not expected in the near term.
- Exploitation of haddock at  $F_{ref}$  with current fishing practices may compromise the achievement of rebuilding objectives for this cod stock due to the potential for discarding of cod.

**Fishery**

Catches (thousands of tonnes) <sup>1</sup>

Year		1998	1999	2000	2001	2002
Canada	Quota	1.8	1.8	1.6	2.1	1.3
	Catch	1.9	1.8	1.6	2.1	1.4
USA	Quota					
	Catch	0.8	1.2	0.7	1.4	1.4
Combined	TAC					
	Catch	2.7	3.0	2.3	3.6	2.8

<sup>1</sup>Includes available discard estimates

**Combined Canada/USA catches**, which averaged about 17,900 t between 1978 and 1992, peaked at 26,000 t in 1982 and declined to 1,800 t in 1995, the lowest observed. Landings since 1999 have been about 3,000 t. Catches in 2002 decreased by 22% from 2001, due to reduced Canadian landings. Canada typically accounts for over 65% of the total landings but this was reduced to about 50% in 2002. (Figure 1)

**Canadian catches** decreased from 2,200t in 2001 to 1,350t in 2002, but were above the quota of 1,248 t. In 2002, most gear sectors reached their allocation. Landings from fixed gear components have been dominant in recent years. For 1995 only, cod fishing was restricted to bycatch. Since 1995, with reduction in cod quotas, targeting for cod by the Canadian groundfish fishery has become uncommon. Also, since 1995, industry imposed self-regulation to avoid overrunning allocations, including directing for haddock in early June and late fall when cod bycatch was low. The Canadian groundfish fishery on eastern Georges Bank has been closed from January to May inclusive, since 1994. About 10% of landed weight was observed and all landings have been subject to 100% dockside monitoring. Discards of cod by the Canadian scallop fishery were estimated to be 87 t in 2001 and 75 t in 2002. Estimates of cod less than 43 cm taken in the Canadian groundfish fishery have been less than 1% of the total in recent years.

**USA catches** for 1995-98 ranged from 557 t to 795 t. USA catches increased from 795 t in 1998 to 1,150 t in 1999 and declined to 660 t in 2000 and again increased to over 1,300 t in 2001 and 2002. Since December of 1994, a year-round closure of Area II has been in effect. Minimum mesh size limits were increased in 1994 and again in 1999. Days-at-Sea were also used as an additional measure for effort reduction.

The 1998 year-class at age 4 (48%) and the 1996 year-class at age 6 (18%) dominated the **combined Canada/USA 2002 fishery**. The proportional catch at age in 2002 was similar to that forecast from the yield projection of 2002.

## ***State of Resource***

The state of the resource was based on results from an age structured analytical assessment (VPA) that used fishery catch statistics and sampling for size and age composition of the catch for 1978 to 2002. The VPA was calibrated to trends in abundance from three bottom trawl research surveys, NMFS spring, NMFS fall and DFO. Retrospective analysis indicates a pattern of inconsistencies with a tendency to over or underestimate fishing mortality, biomass and abundance at age 1 relative to the terminal year estimate. The extent of this pattern was similar to that seen in 2002 and was not of particular concern.

There was a substantial decline in **adult (3+) stock biomass** from about 45,000 t in 1990 to about 8,700 t in 1995, the lowest observed. The biomass subsequently increased to 18,300t in 2001 but declined to 13,300t at the beginning of 2003 (80% Confidence Interval: 10,600 t – 16,300 t). Almost all of the increase in the late 1990's has been the result of growth and survival to ages 5+ of the 1992, 1995 and 1996 year-classes. Lower weights-at-age in the population in 2002-2003 and the continuing low recruitment have contributed to the recent decline. (Figure 2)

**Recruitment** has been below the 1978-98 average of 7.5 million since 1990. The 1996 and 1998 year-classes, at about 4 million, appear to be the strongest since the 1990 year-class. Recruitment since the 1998 year-class has been less than 2 million. (Figure 2)

The **fishing mortality for ages 4-6** increased rapidly between 1989 and 1993 to over 0.9, much greater than the fishing mortality reference,  $F_{ref} = 0.18$ . In 1995, it declined to near  $F_{ref}$  due to restrictive management measures. Since 1995, fishing mortalities have been greater than the  $F_{ref}$  ( $F_{2002} = 0.23$ ; 80% Confidence Interval: 0.19 - 0.32).

## ***Harvest Reference Points***

The established fishing mortality threshold reference,  $F_{ref} = 0.18$ , was maintained. The pattern of recruitment indicates that the chance of a strong year-class is significantly enhanced for adult biomass above about 25,000 t. (Figure 3)

A forecast simulation, assuming stable size at age, fishery exploitation pattern by age and natural mortality and with re-sampling from the observed recruitment using two biomass stanzas (below and above 25,000 t), indicated that the median 2005 rebuilding biomass (ages 3+) was about 17,700 t (25% and 75% quartiles: 15,800 t – 19,600 t) if the resource were exploited at  $F_{ref} = 0.18$ .

Other attributes like survivorship to age 1, age structure and spatial distribution reflect possible fluctuations in the productive potential and can be used to qualify reference points and acceptable risk. Examination of the recruits per adult

biomass ratio suggests that **survivorship to age 1**, has been lower than the norm in recent years. In both absolute numbers and percent composition, the **population age structure** displays an increasing representation of age groups, reflecting improving recruitment and lower exploitation, particularly at younger ages, since 1995. The **spatial distribution** patterns observed during the most recent bottom trawl surveys were similar to the average patterns over the previous five years.

### ***Outlook***

The outlook is provided in terms of the possible consequences for alternative catch quotas in 2004 with respect to the harvest reference points. Uncertainty about year-class abundance generates uncertainty in forecast results. This uncertainty is expressed in the outlook as the risk of exceeding  $F_{ref} = 0.18$ , the risk of not achieving a biomass increase and the risk that the biomass will decline below the median 2005 rebuilding biomass of 17,700 t.

Projection assuming the 2003 catch will equal the 2002 catch of 2,800 t indicates that a combined Canada/USA yield of about 1,300 t in 2004 has about a 50% risk of exceeding  $F_{ref}$ . At a yield in 2004 of 1,300 t, there is about a 20% chance of a decrease in biomass from the beginning of year 2004 to the beginning of year 2005. However, the probability of being below the median 2005 rebuilding biomass of 17,700 t is very high. Continuing poor recruitment since 1996, lower weights-at-age and lower partial recruitment to the fishery of older age groups directly impact yield projections. (Figure 4)

The risk calculations are dependent on the model assumptions and data used in the analyses. Though these assumptions were deemed most suitable, there may be other plausible assumptions. These calculations do not include uncertainty due to variations in weight at age, partial recruitment to the fishery, natural mortality, systematic errors in data reporting or the possibility that the model may not reflect the stock dynamics closely enough. The risk profiles provide a general sense of the associated uncertainties and can assist in assessing the consequences of alternative catch quotas.

### ***Special Considerations***

Consistent management by Canada and the USA is required to ensure that conservation objectives are not compromised.

Comparison of adult biomass and resultant recruitment indicates that the relatively weak post-1992 year-classes have been produced at biomass levels of 25,000 t or less. At an adult biomass of less than a 25,000 t, average recruitment is about 2 million while above 25,000 t, average recruitment is about 9 million. Subsequent poor recruitment will lead to reduced prospects for an increase in biomass towards a 25,000t threshold.

Recruitment success may be influenced by environmental (water temperature, salinity), hydrographic (currents, tidal mixing), biological (spawning stock, egg viability, predation, competition) and fishery (spawning disruption, habitat change) factors. The extent to which these and other potential factors influence recruitment success for Eastern Georges Bank cod is unknown. However, the empirical evidence on spawning stock biomass and recruitment suggests that below about 25,000 t recruitment is variable but lower than that associated with higher biomass levels.

With the current poor recruitment and fishing mortality near the present levels and above  $F_{ref}$ , improvement in stock status is not expected in the near term.

Partial recruitment to the fishery has changed since 1994 as a result of seasonal and spatial area closures and the bycatch nature of the fishery due to reduced allocations. Catchability of ages 5+ cod has been reduced and the exploitation pattern has a substantial declining trend. This pattern may not persist for the long term but is expected to remain for the short term and the 2000-2002 average is used for yield projection in 2004.

Cod and haddock are often caught together in the 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  $F_{ref}$  with current fishing practices may compromise the achievement of rebuilding objectives for this cod stock due to the potential for discarding of cod.

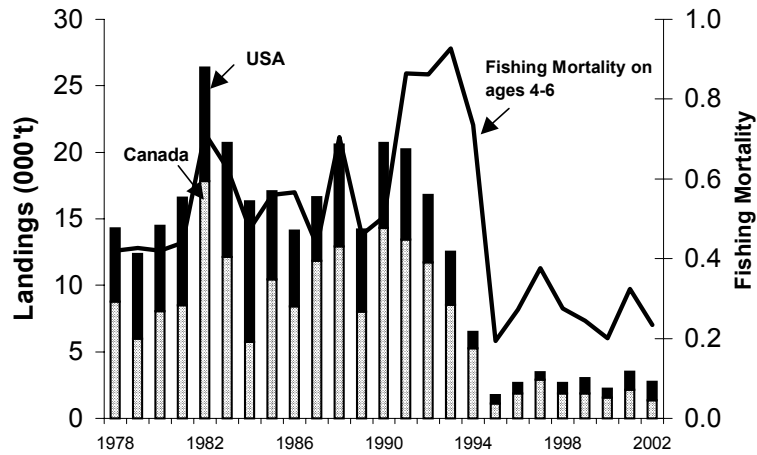


Figure 1. Catches and fishing mortality.

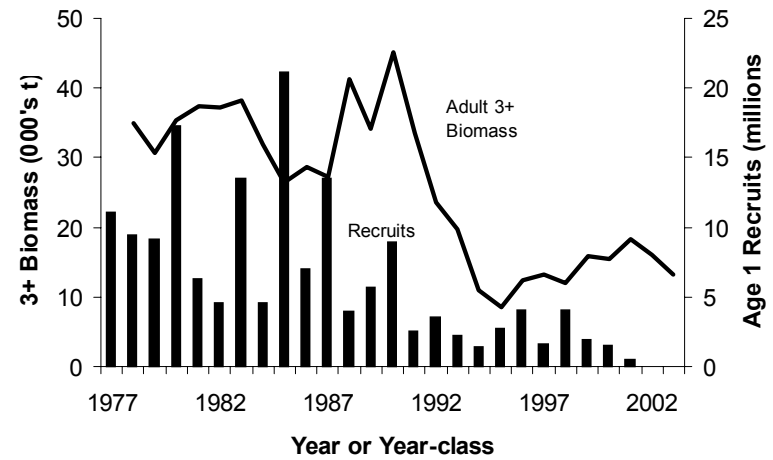


Figure 2. Biomass and recruitment.

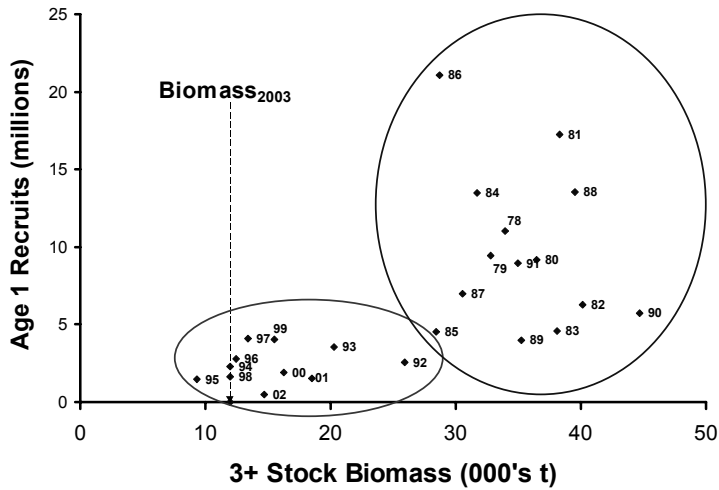


Figure 3. Stock recruitment patterns.

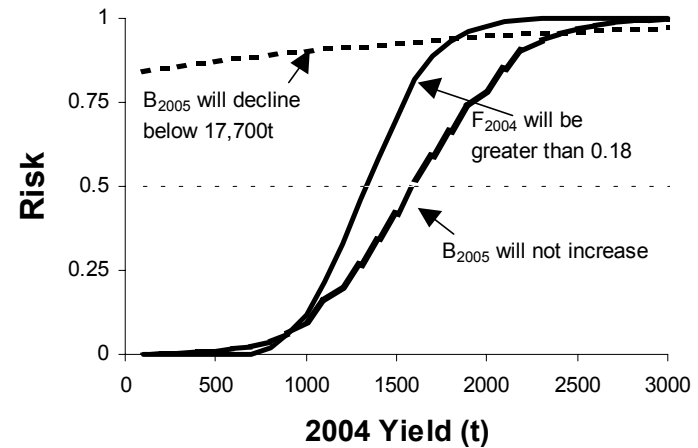


Figure 4. Projection risks.