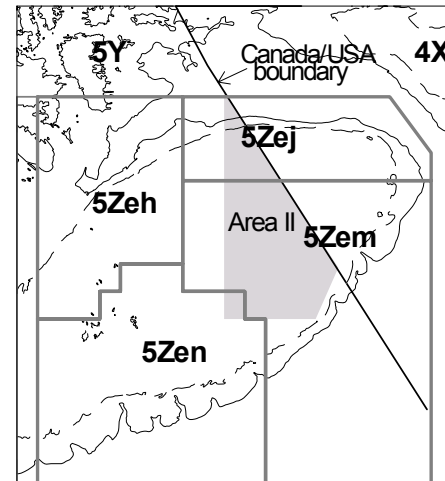


## Yellowtail Flounder on Georges Bank



### Background

Yellowtail flounder range from Labrador to Chesapeake Bay and are considered relatively sedentary. A major concentration of yellowtail occurs on Georges Bank to the east of the Great South Channel. While tagging work indicates limited movement from Georges Bank to adjacent areas, knowledge of seasonal movement of yellowtail flounder on Georges Bank is poor. Yellowtail flounder are most commonly caught at depths between 37 and 73 meters (20 and 40 fathoms).

On Georges Bank, spawning occurs during the late spring period peaking in May. From the distribution of both ichthyoplankton and mature adults, it appears that spawning occurs on both sides of the international boundary. Yellowtail flounder appear to have variable maturity schedules, with age two females considered 40% mature during periods of high stock biomass to 90% mature during periods of low stock biomass.

The Canadian fishery is mainly pursued using otter trawl gear from vessels less than 65'. This directed fishery for yellowtail flounder is a relatively recent development, with significant catches first occurring after the introduction of specialized gear in 1993. Most vessels use trawls equipped with small rollers and employ less headline flotation, giving a smaller vertical opening. The fishery occurs in a relatively limited portion of Georges Bank known as the Yellowtail Hole (5Zm), and with current management restrictions, operates in the latter half of the year only. Both Canada and the USA employ the same management unit.

### Summary

- The combined Canada/USA catch has been increasing since 1995, and in 2001 was 6,790 t, slightly less than 2000.
- Canadian fishermen reported lower catch rates in 2001 compared with 2000. Since 1999, commercial catch rates appear to have declined more rapidly than the DFO survey abundance index for the Canadian portion of the bank < 90 m depth.
- Population biomass (age 1+) has increased 12 fold since 1995, and is at the highest observed level since 1973. The age structure is improving but older fish are still under-represented.
- Recent recruitment has improved relative to the 1980s, and the 1997 year-class appears to be the strongest since 1980. Early estimates of the 2000 year-class indicate that it is of moderate strength.
- Exploitation rates on ages 4+ have been near or below  $F_{0.1}$  since 1999, while exploitation on age 3 has not decreased since 1997.
- At the  $F_{0.1}$  yield of 10,300t, the probability of achieving a 10% increase in age 3+ biomass from the beginning of the year 2002 to 2003 is about 75%.

## The Fishery

Catches (thousands of tonnes)

Year	1970-1979 Avg.	1980-1989 Avg.	1990-1997 Avg <sup>4</sup>	1998	1999	2000	2001
TAC <sup>1</sup>	-	-	-	1.2	2.0	3.0	3.4
Canada <sup>2</sup>	-	-	1.0	1.2	2.0	2.9	2.9
USA	12.0	5.2	1.8	1.9 <sup>3</sup>	2.5 <sup>3</sup>	4.0 <sup>3</sup>	3.9
Totals				1.8	3.1	6.9	6.8

<sup>1</sup> Canadian quota only.

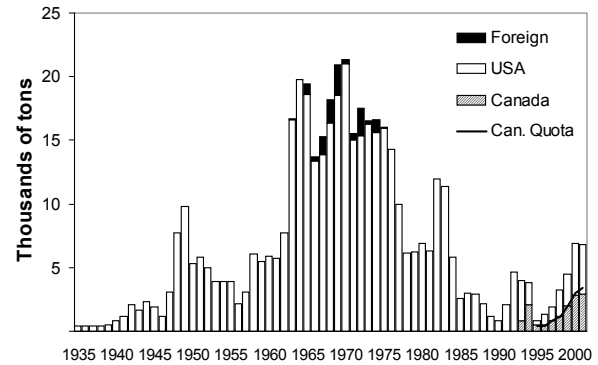
<sup>2</sup> Canadian yellowtail catches, plus prorated unspecified flounder.

<sup>3</sup> Provisional values, provided by US NMFS, includes estimated discards.

<sup>4</sup> Canadian average included 1993 through 1997 only.

**Total catches** of Georges Bank yellowtail flounder reached historical highs of about 20,000 t during the mid 1960s to mid 1970s. The USA fishery has made most of the catches, although there were catches by other countries during the late 1960s and early 1970s. The combined Canada/USA catch has been increasing since 1995, and in 2001 was 6,790 t, slightly less than 2000.

**The Canadian directed fishery** started in 1993 and landings of 2,139 t occurred in 1994 when the fishery was unrestricted. Under quota control for the first time in 1995, catches were 472 t. The 2001 Canadian catches were 2,938 t, against a TAC of 3,450 t. In the Canadian scallop fishery, yellowtail flounder are by-catch and, by regulation, must be discarded. While no estimates of removals by the Canadian scallop fleet are available since 1995, the location of the scallop fishery has recently shifted to northeast peak of Georges Bank, away from the main area where yellowtail are concentrated. A monitoring program was conducted in 2001 to examine yellowtail flounder bycatch in the offshore scallop fishery but results are not yet available.



Canadian catches of unspecified flounder from Georges Bank have been substantial in the past (523 and 811 t in 1993 and 1994, respectively). Industry sources have indicated that most catches of unspecified flounders were yellowtail flounder. With improvements in dockside monitoring, catches of unspecified flounder have decreased substantially, and in 2001 were estimated to be only 45 t and 6 t for 5Zm and 5Zj, respectively. In all years, catches of unspecified flounder, assumed to be yellowtail flounder, have been included in the stock assessment. A small amount of summer flounder (*Paralichthys dentatus*) was captured in the 2001 Canadian fishery, but since it does not usually occur in Canadian waters, it was reported as unspecified flounder. The estimated catch of summer flounder (26 t) was subtracted from the total catch.

**USA catches** in 2001 were 3,852 t, compared with 4,036 t in 2000 (a decrease of 5%). The principle fishing gear used in the USA fishery is the otter trawl, but scallop dredges and sink gillnets contribute some catches. In recent years, otter trawls caught greater than 95% of total catches from the Georges Bank stock, dredges caught 2-5% of annual totals, and gillnet catches were less than 0.1%. Current levels of recreational fishing are negligible. Discarding of small yellowtail has been an important source of mortality due to historical intense fishing pressure, discrepancies between minimum size limits

and gear selectivity prior to 1995, and recently imposed groundfish trip limits for the scallop dredge fishery within Closed Area II. Since there was no exemption scallop fishery within the closed area in 2001, most discards would have originated from the bottom trawl fishery. Previous estimates of trawl discards were 89 t for 1999 and 57 t for 2000. Since no estimate for 2001 was available, an additional 60 t was added to USA landings to represent discards from the trawl fishery.

The **combined Canada and USA catch-at-age** (including discards) indicate that there are few ages in the exploited population with ages 2-4 representing most of the catch. Although the age composition of the fishery is generally comparable to that observed during earlier periods, the strong 1998 year-class (Age 3) dominated the catch at age. Age 1 fish have not been apparent in the catch at age since 1995 due to lower selection of the fishing gear at that age. In addition, ages 5 and older are comparatively rare. While the Canadian fishery was well sampled in 2001, low sampling rates for the USA fishery and the continued lack of production aging for the Canadian fishery has reduced the reliability of the reconstruction of the catch and length at age in recent years.

### ***Environmental Conditions***

In recent years (1998-2001), water temperatures on Georges Bank have generally been about 1°C above normal. This is in contrast to the Scotian Shelf where temperatures in 2001 were colder than normal and lower than in 2000. Vertical mixing on Georges Bank, as indicated by the annual mean difference in water density between 0 and 50m, has remained relatively constant as it has been for the past 20 years. Both the shelf/slope front and Gulf Stream were further offshore in 2001 compared to

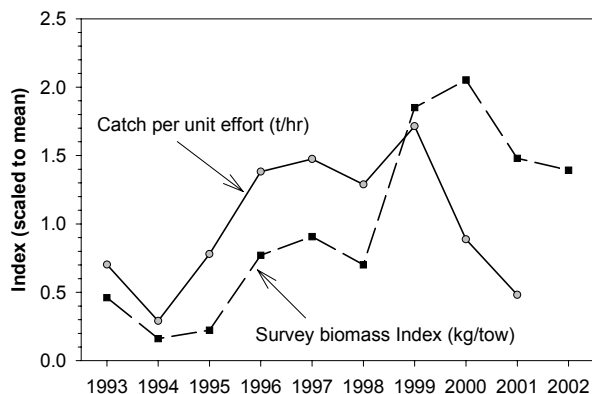
2000. While the shelf/slope front had moved seaward of its long-term (1971-2000) mean position, the Gulf Stream remained landward of its long-term mean. Although not covering Georges Bank, information from the July groundfish surveys (July) and satellite ocean colour data (full year), suggest the chlorophyll levels in surface waters were similar in 2001 to 2000 and similar to the long-term mean. Connections between the oceanographic conditions and the status of assessed fish stocks within 5Z are still elusive and remain under investigation.

### ***Resource Status***

A virtual population analysis (VPA) was employed that incorporated indices of abundance from the Department of Fisheries and Oceans (DFO) spring survey, and the National Marine Fisheries Service (NMFS) spring, fall and scallop surveys (young yellowtail flounder are a common by-catch in the NMFS scallop survey). In light of the concerns with the reliability of the recent catch at age, an age-aggregated surplus production model was also used. That approach required total catch as input, as well as indices of total biomass from the NMFS and DFO spring surveys and the NMFS fall survey, but not age composition. While the DFO spring 2002 survey biomass index was used for the production model, the 2002 age-specific indices were not used for tuning the VPA because age determinations for this survey were not available.

A **catch per unit effort (CPUE) index** for Canadian mobile gear indicates that commercial fishery catch rates increased between 1994 and 1999, but dropped off sharply thereafter. In comparison with the DFO survey biomass index for the Canadian portion of the bank <90 m, the CPUE series has a much steeper decline after 1999,

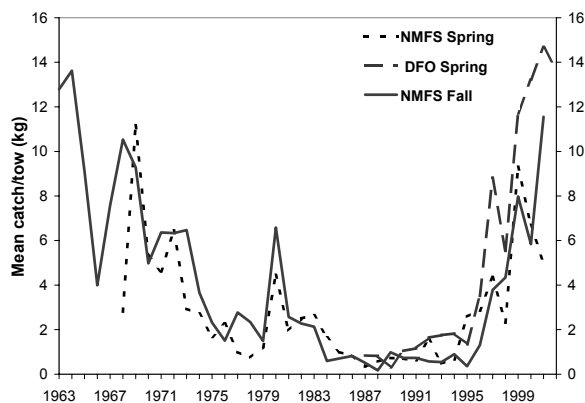
indicating that catch rates within the “Yellowtail Hole” area have declined more rapidly in recent years than the Canadian portion of the bank as a whole.



Some of the variation in past catch rates have been attributed to the developing skill of fishermen, changes in gear configuration and variation in relative abundance. Fishermen with a history of fishing yellowtail clearly noted a decline in catch rates in 2000 and 2001. Catch rate indices will require further investigation before they are used as an index of abundance.

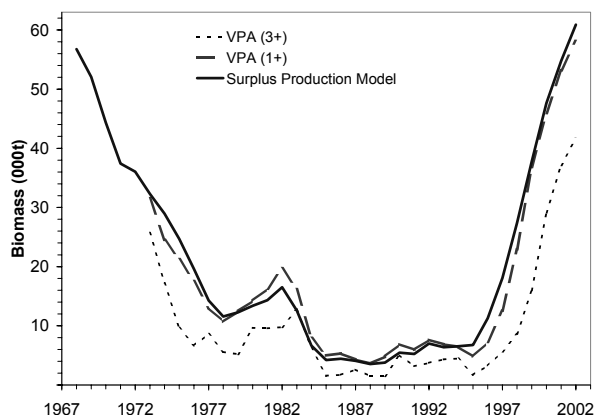
There are three bottom trawl **research surveys** conducted annually on Georges Bank that cover the entire management unit. They include the DFO spring (February) survey, the NMFS spring survey (April) and the NMFS fall (October).

All three surveys show a rapid increase in abundance from 1994 to present, preceded by an earlier period in the 1980s when abundance was considerably lower.



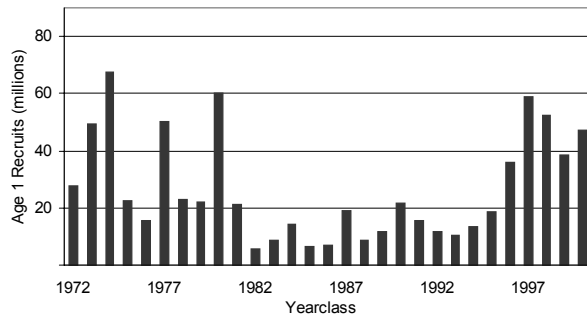
Information from the NMFS scallop survey and all three bottom trawl surveys support the view that recruitment during the 1990s was considerably better than that observed during the 1980s.

Estimates of **total biomass** (ages 1+) from both VPA and surplus production models show good agreement and follow a decline through the 1980s and a rapid 12-fold increase during the 1990s to the highest level observed since 1973. Total biomass in 2002 was estimated as 58,000 t and 60,900 t from the VPA and surplus production models, respectively. Biomass for ages 3+ (considered to reflect mature biomass) shows a similar trend and was estimated at 42,000 t at the beginning of 2002.

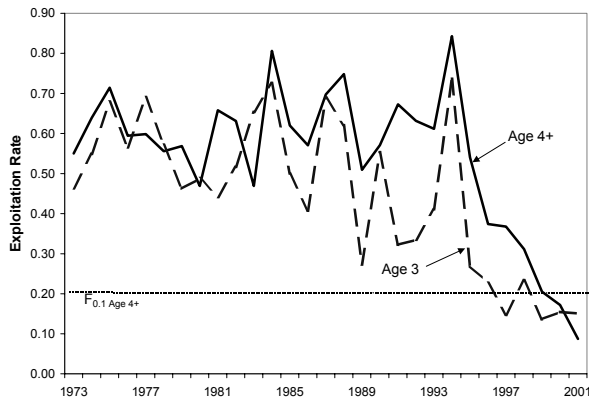


**Recruitment** estimates were derived from the VPA and show that there have been several good year-classes in recent years. The 1997 year-class is the strongest in the

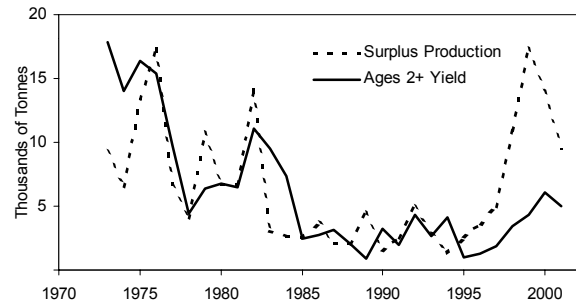
series since 1980, and early estimates of the 2000 year-class indicate that it is of moderate strength.



The fully recruited (ages 4+) exploitation rate underwent a marked decline from 1994-2001 and was near or below  $F_{0.1}$  (20%) in the last 3 years. However, exploitation on age 3 has not decreased proportionately since 1997 due to increased partial recruitment to the fishery.



Using the VPA results, it is possible to partition **biomass production** into growth and recruitment components. From such an analysis, it appears that growth, on average, contributes about 50% to total production. The proportion contributed by growth has not varied significantly over time. When production is compared with yield from the fishery, it can be seen that since 1995, there has been considerable production in excess of fishery removals (ages 2+ yield), which has allowed the biomass to increase.



### Sources of Uncertainty

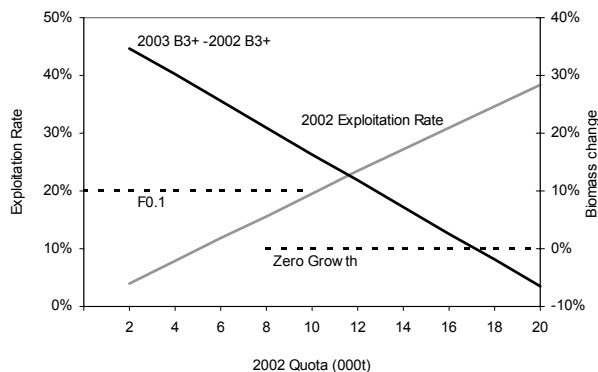
Continued poor sampling of the USA fishery and the absence of age information for the Canadian fishery removals have raised concerns about the reliability of the VPA results. This year, a retrospective pattern was noted again, with a tendency toward overestimating abundance of older ages (ages 5+) since 1994 and underestimating fully recruited fishing mortality. However, no pattern was apparent in the estimates of abundance for younger ages and for total biomass.

The surplus production model attempts to describe long term population dynamics in a simple model which projects past stock productivity forward. However, it is not clear whether past stock productivity will always be a good predictor of stock dynamics. Further, surplus production models may fail to capture the dynamic changes that occur in recruitment, growth and exploitation patterns at age. Therefore, forecasts from surplus production are not considered reliable.

### Outlook

The  $F_{0.1}$  yield in 2002 is 10,300 t (Canada and USA combined). If fished at  $F_{0.1}$  (20% exploitation) in 2002, the age 3+ biomass is expected to increase by 13% and is estimated to be 48,066 t by the beginning of 2003. The 2000 year-class is estimated to contribute 26% of total beginning of year

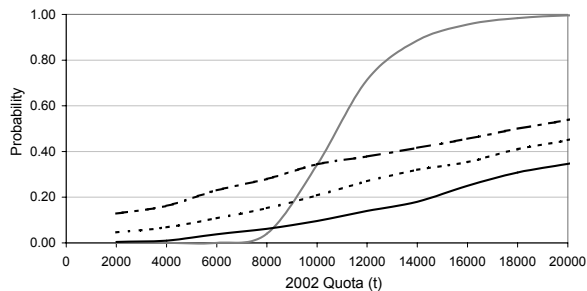
biomass in 2003, however, this year-class is not well estimated.



For example, at a yield of about 10,000 t, the biomass is not likely to decrease and there is an 80% probability of achieving a 10% increase from the beginning of the year 2002 to 2003.

The calculations do not include uncertainty in weights at age, partial recruitment to the fishery and natural mortality, or systematic errors in data reporting and model mismatch.

- Exploitation rate will be greater than 20%
- Biomass 2003 will be less than Biomass 2002
- - - Biomass 2003 will not increase by 10%
- - - Biomass 2003 will not increase by 20%

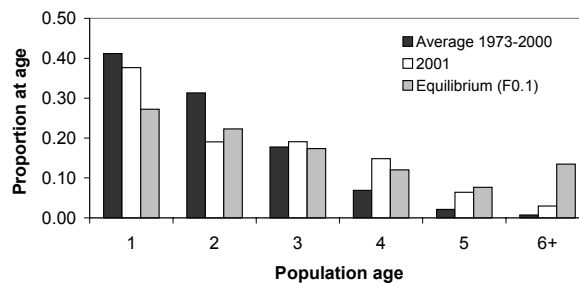


**Management Considerations**

Last year’s stock assessment indicated that with a combined F<sub>0.1</sub> catch of 9,200 t in 2001, no increase in age 3+ beginning of year biomass was anticipated from 2001 to 2002. The actual combined Canada/USA catch of 6,790 t in 2001 resulted in an exploitation rate of 9%, and the age 3+

biomass at the beginning of 2002 was 41,670 t, an increase of 11%.

Although the population age structure has improved in recent years and population biomass has increased, older fish are still under-represented.



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