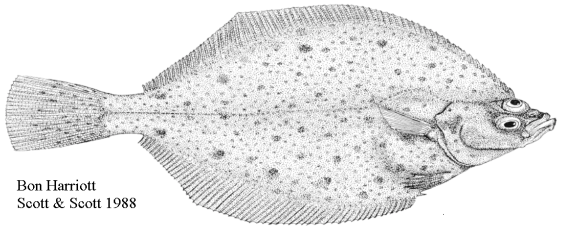


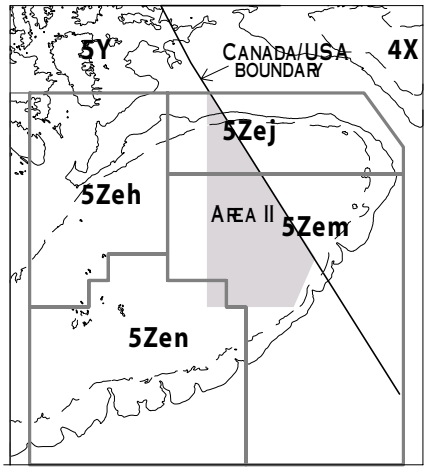
Yellowtail Flounder on Georges Bank

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 2000 was 6,895 t.
- The strong 1997 year-class (age 3) dominated both Canadian and USA catches.
- Fishermen reported lower catch rates in 2000 compared with 1999.
- Population biomass (age 1+) has increased 10 fold since 1995, and is at the highest observed level since 1973. However, the age structure is truncated and dominated by younger ages.
- Recent recruitment has improved relative to the 1980s, and the 1997 year-class appears to be the strongest since 1973. The 1996, 1998 and 1999 year-classes appear to be of moderate strength.
- Exploitation rates on ages 4+ have been less than $F_{0.1}$ (20%) in 1999 and 2000. Exploitation at ages 2 and 3 has not declined to the same extent.
- At the F0.1 yield of 9,200t, which corresponds to about 50% probability of exceeding F0.1, the biomass is not likely to decrease and there is an 80% probability of not achieving 10% increase from the beginning of the year 2001 to 2002.

The Fishery

Catches (thousands of tonnes)

Year	1970-1979 Avg.	1980-1989 Avg.	1990-1996 Avg[4]	1997	1998	1999	2000
TAC[1]	-	-	-	0.8	1.2	2.0	3.0
Canada[2]	-	-	1.0	0.8	1.2	2.0	2.9
USA	12.0	5.2	1.9	1.0[3]	1.9[3]	2.5[3]	4.0[3]
Totals				1.8	3.1	4.5	6.9

[1] Canadian quota only.

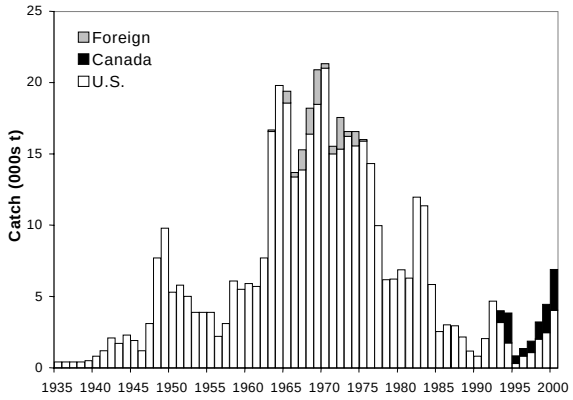
[2] Canadian yellowtail catches, plus prorated unspecified flounder.

[3] Provisional values, provided by US NMFS, includes estimated discards.

[4] Canadian average included 1993 through 1996 only.

Total catches of Georges Bank yellowtail flounder reached historic 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 Canadian directed fishery started in 1993 and landings of 2139 t occurred in 1994 when the fishery was unrestricted. Under quota control for the first time in 1995, catches were 472 t. The 2000 Canadian catches were 2859 t, against a TAC of 3000 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 program is being considered for 2001 to examine yellowtail flounder bycatch in the offshore scallop fishery.



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 2000 were estimated to be only 23 t and 22 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.

USA catches in 2000 were 4036 t, compared with 2474 t in 1999 (an increase of 85%). 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 historically 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. Of the total 2000 USA catch, it was estimated that 301 t were discarded in the offshore scallop fishery

(80% from Closed Area 2) and 57 t in the groundfish trawl fishery. U.S. trawlers that land yellowtail flounder generally fish on the southwest flank of the Bank west of the closed area.

The combined Canada and USA **catch at age** information (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 1997 year-class (age 3) dominated the catch at age. Age 1 has 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 2000, low sampling rates for the USA fishery and the continued lack of a Canadian program for age determinations has reduced the reliability of the reconstruction of the catch and length at age in recent years.

Environmental Conditions

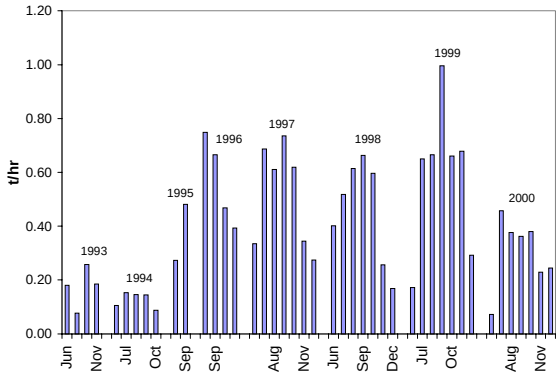
Examination of the physical and biological oceanographic conditions on Georges Bank indicates that water temperatures in recent years (1998-2000) have been about 1°C above normal. The temperature conditions that were observed during the 2000 and 2001 Canadian groundfish bottom-trawl surveys are consistent with this pattern. Although the recent temperatures are above normal, they are still within the range normally associated with demersal stages of cod and haddock caught within the Georges Bank and Scotian Shelf areas. The degree of vertical mixing, as indicated by the annual mean difference in water density between 0 and 50m, has been relatively constant for the past 20 years. The shelf/slope front and Gulf Stream was closer to Georges Bank in 2000 than the long-term normals and the concentration of chlorophyll on the Bank was higher in 2000 than in 1999 or 1998. 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 National Marine Fisheries Service (NMFS) and Department of Fisheries and Oceans (DFO) spring surveys, the NMFS fall survey and the NMFS scallop survey (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 2001 survey biomass index was used for the production model, age-specific indices were not used for tuning the VPA because age determination for the survey was not available and results from substitution of other age information did not track cohorts well.

Canadian mobile gear **catch rates** were examined for the directed fishery in 5Zm. Catch rates increased between 1994 and 1996, remained constant from 1996 to 1998, then increased in 1999. In 2000, catch rates dropped considerably from the previous year. Based on past discussions with industry, it was concluded that the increases in catch rates up to 1996 in this relatively new fishery probably reflect increased biomass, but were also influenced by the developing skill of fishermen as well as gear development. It was also noted that the increase in catch rates from 1998 to 1999

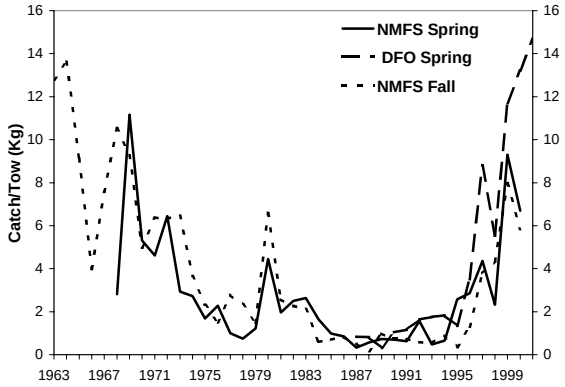
may under-represent the increase in abundance, since a significant number of fishermen switched to roller gear that minimized the catch of smaller fish. Industry believed that such gear would have lower catch rates compared with the gear employed in 1998.



At the March 2001 industry consultation, it was confirmed that catch rates were lower during the 2000 fishery. While several factors may have had a negative effect on catch rates, including use of larger mesh gear (165 mm square), the addition new less-experienced participants in the fishery and movement to areas with lower catch rates to avoid skates, fishermen with a history of fishing yellowtail clearly noted a decline. Catch rate indices will require further investigation before they are used as an index of abundance.

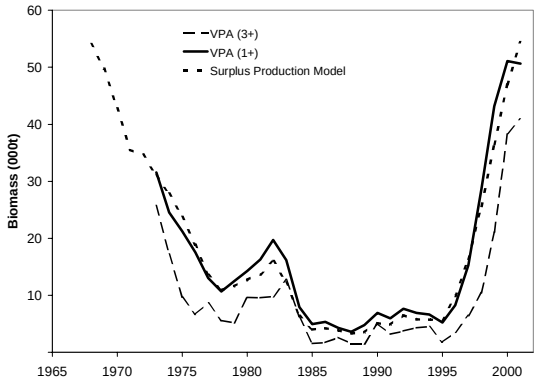
There are three bottom trawl **research surveys** conducted annually on Georges Bank that cover the entire management unit. They include the DFO spring (February) survey, the NMFS spring survey (April) and the NMFS fall (October).

The NMFS spring survey series, which starts in 1968, shows an increasing trend from 1994 to 1999, with a slight decrease in 2000. The NMFS fall survey, which has the longest running time series, also shows an increase from 1995 to 1999, with a slight drop in 2000. The mean weight per tow from the DFO spring survey has also been following an increasing trend, with the 2001 value being the highest in the series.

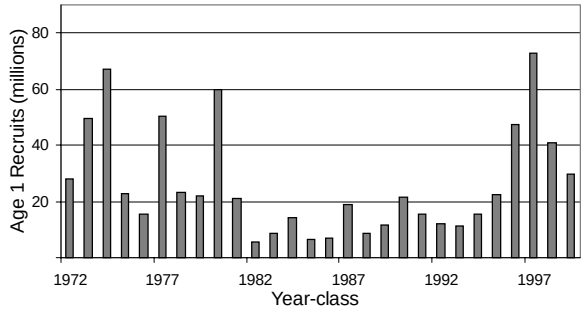


Information from the NMFS scallop survey (age 1 yellowtail flounder are a common by-catch and are used as an index of recruitment in this assessment) support the view that recruitment during the 1990s was considerably better than that observed during the 1980s.

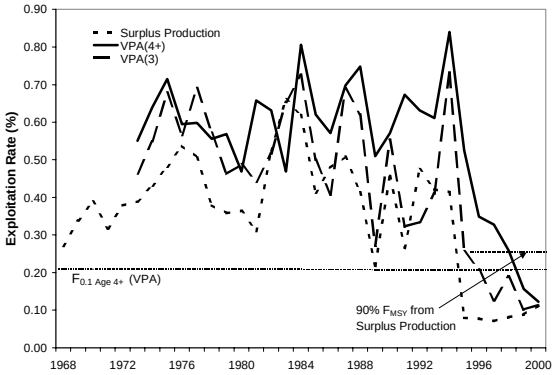
Estimates of **total biomass** (ages 1+) from both assessment models show good concurrence. Both models indicate a steady decline in total biomass from the early 1970s, an increase in the early 1980s attributable to the strong 1980 year-class, then a decrease to under 4,000 t in 1988. Total biomass has been recovering rapidly since 1995, and in 2001 was estimated as 54,420 and 50,629 t from the surplus production model and VPA models, respectively. Biomass for ages 3+ (considered to reflect mature biomass) shows a similar trend and was estimated at 40,899 t at the beginning of 2001.



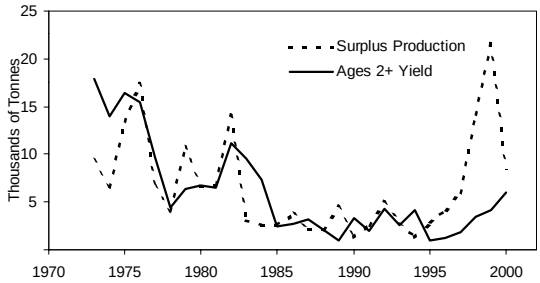
Recruitment estimates were derived from the VPA (1973 to 2000). The 1997 year-class is the strongest in the series, and adjacent year-classes are also strong relative to those observed in 1980s.



Biomass weighted fishing mortality from the VPA and the surplus production model show similar patterns of exploitation rate. The fully recruited (age 4+) exploitation rate underwent a marked decline from 1994-2000 and was below F0.1 in the last 2 years. However, exploitation on ages 2 and 3 has not decreased proportionately and the partial recruitment to the fishery for these ages has increased.



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. This is particularly noteworthy in 1999, when total production was about 21,500 t, considerably in excess of total removals by the fishery. In 2000, surplus production model was estimated to be much lower, at 8,460 t. The yield for ages 2+ has increased steadily since 1995 and in 2000 was estimated to be 5,900 t.



Sources of Uncertainty

Continued low levels of sampling for 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 since 1994 and underestimating fully recruited fishing mortality.

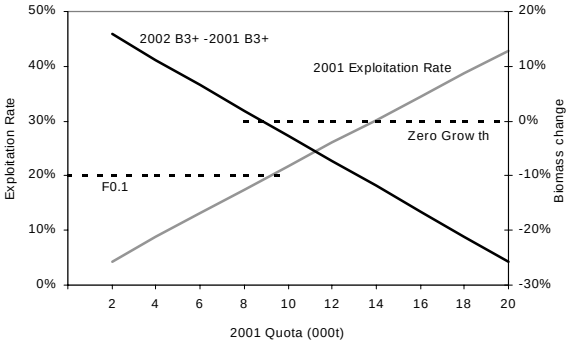
The surplus production model attempts to describe long term population dynamics in a simple model which projects past stock productivity forward. However, it is not clear whether past stock productivity will always be a good predictor of stock dynamics. Further, surplus production

models may fail to capture the dynamic changes that occur in recruitment, growth and exploitation patterns at age.

Outlook

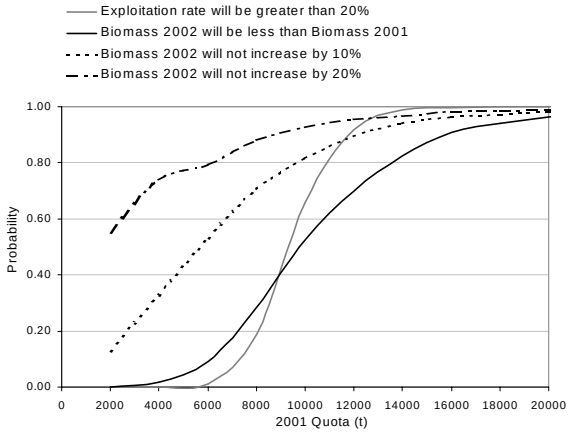
While the historical population reconstruction from the VPA and the surplus production model show concurrence, projections from the two models diverge significantly. The projection results from the surplus production model imply high equilibrium recruitment levels that are not consistent with historical estimates. Accordingly, only the VPA projection results are given.

The $F_{0.1}$ yield in 2001 is 9200 t (Canada and USA combined). If fished at $F_{0.1}$ (20% exploitation) in 2001, the age 3+ biomass is not expected to change and is estimated to be 40,389 t by the beginning of 2002. The dominant 1997 year-class is expected to contribute about 40% of the expected yield in 2001, and comprises about 32% of the total biomass.



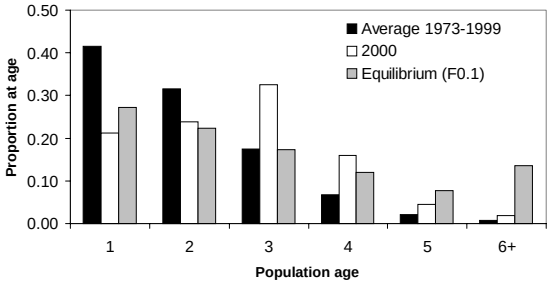
At the F0.1 yield of 9,200 t, which corresponds to about 50% probability of exceeding F0.1, the biomass is not likely to decrease and there is an 80% probability of not achieving 10% increase from the beginning of the year 2001 to 2002.

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.



Management Considerations

Last year's stock assessment indicated that with a combined $F_{0.1}$ catch of 8000 t in 2000, an increase in age 3+ beginning of year biomass of about 10% was anticipated from 2000 to 2001. The actual combined Canada/USA catch of 6895 t in 2000 resulted in an exploitation rate of 12%, and the age 3+ biomass at the beginning of 2001 was 41,000 t, an increase of 6%.



Although the population age structure has improved in recent years and population biomass has increased, the current age structure remains truncated, with fewer older fish and is dominated by younger ages.

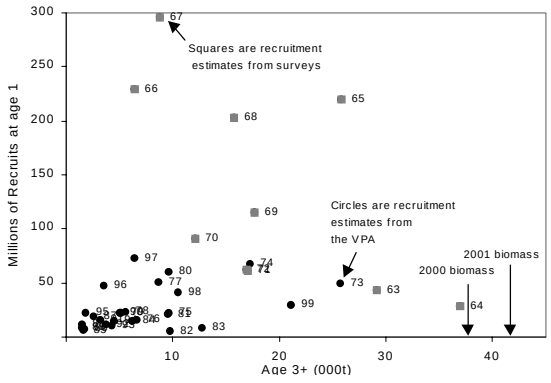
DFO and NMFS surveys indicate that the **percentage** of biomass in the Canadian portion of the management unit has generally been about 40-60% in recent

years. There is, however, considerable interannual and seasonal variation in the proportion of biomass in Canadian waters.

Percentage of Biomass on Canadian Side

Year	DFO (Feb)	NMFS (Apr)	NMFS (Oct)
1992	22	65	72
1993	64	64	79
1994	21	54	70
1995	40	71	51
1996	53	55	15
1997	25	86	49
1998	60	36	63
1999	39	67	50
2000	38	63	16
2001	25	N/A	N/A

Levels of age 3+ biomass less than 7500 t have been associated with relatively low levels of recruitment. Few data are available to measure the magnitude and variability of recruitment at current high biomass levels.



For more Information:

Contact: Heath Stone
Dept. of Fisheries & Oceans
St. Andrews Biological Station
531 Brandy Cove Road
St. Andrews, N.B. E5B 2L9

Tel: (506) 529-8854
Fax: (506) 529-5862
E-Mail:
stoneh@mar.dfo-mpo.gc.ca

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