

Bon Harriott
Scott & Scott 1988

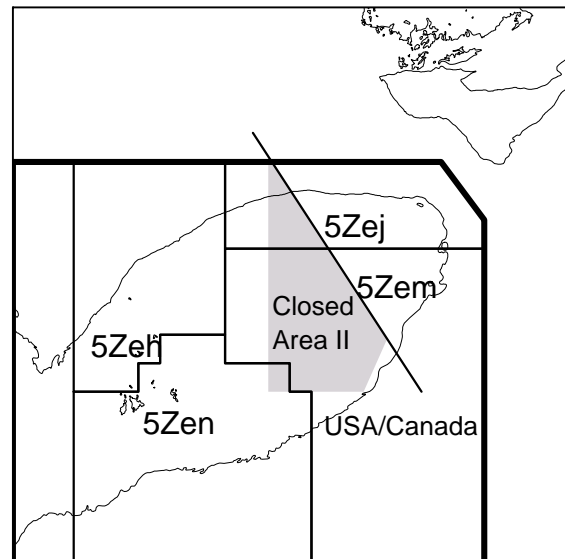
Yellowtail Flounder on Georges Bank

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 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. 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. Both Canada and the USA employ the same management unit (5Zej, 5Zem, 5Zeh, 5Zen).



Summary

- The combined Canada/USA catch has been increasing since 1995, and in 1999 was 4,441 t.
- The area where good catches were observed during the Canadian spring survey increased from 1999 to 2000.
- The age structure of the catch in 1999 was generally comparable with historic periods, but age one fish were less common due to the lower selectivity of current gear for that age. In addition, age seven and older fish still remain under-represented.
- Fishermen reported higher catch rates in 1999 compared with 1998.
- Population biomass has increased since 1995.

- Recent recruitment has improved relative to the 1980s, and the 1997 year-class appears to be the strongest since 1973.
- Exploitation rates have been less than the $F_{0.1}$ target of 20% since 1996.
- At the $F_{0.1}$ yield (8,000 t), there is about a 40% chance of not achieving a 10% increase in biomass from the beginning of the year 2000 to 2001.

The Fishery

Catches (thousands of tonnes)

Year	1970-1979 Avg.	1980-1989 Avg.	1990-1995 Avg ⁴	1996	1997	1998	1999
TAC ¹	-	-	-	0.4	0.8	1.2	2.0
Canada ²	-	-	1.1	0.5	0.8	1.2	2.0
USA	12.0	5.2	1.9	0.8 ³	1.0 ³	1.9 ³	2.5 ³
Totals				1.3	1.8	3.1	4.5

¹ Canadian quota only.

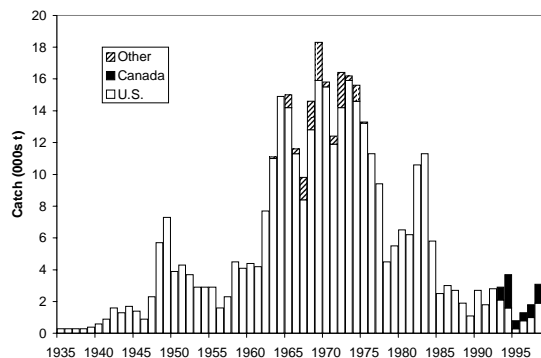
² Canadian yellowtail catches, plus prorated unspecified flounder.

³ Provisional values, provided by USA NMFS, includes estimated discards.

⁴ Canadian average included 1993-1995 only.

Total catches of Georges Bank yellowtail flounder reached historic highs 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 peaked in 1994, with catches of 2142 t. Quota management was introduced in 1995 with catches of 495 t against a quota of 400 t. The 1999 Canadian catches were 1971 t, against a TAC of 2000 t. In the Canadian scallop fishery, yellowtail flounder are by-catch and by regulation, must be discarded. No estimates of removals by the Canadian scallop fleet were available since 1995.



Canadian catches of unspecified flounder from Georges Bank have been substantial (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 1999 were only 11 t from 5Zm and for the purposes of the assessment, were assumed to be yellowtail flounder. In all years, catches of unspecified flounder that were assumed to be yellowtail flounder have been included in the stock assessment.

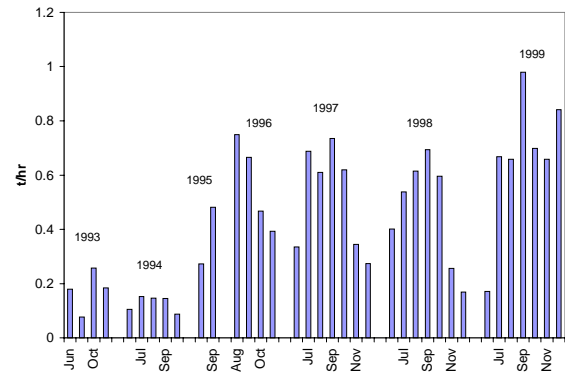
USA catches in 1999 were 2470 t, compared with 1936 t in 1998. The principle fishing gear used in the USA fishery is the otter trawl, but scallop dredges and sink gillnets contribute some catches. In recent years, otter trawls caught greater than 95% of total catches from the Georges Bank stock, dredges 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 1999 USA catch, an estimated 484 t was discarded by the scallop fishery in 1999.

U.S. trawlers that land yellowtail flounder generally target multiple species on the 'Southwest Part' of the Bank and on the northern edge, just west of the closed area.

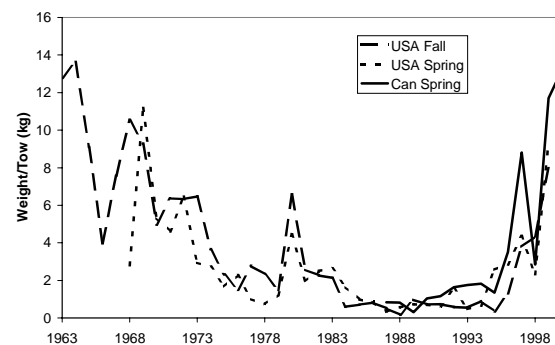
The combined Canada and USA **catch at age** information (including discards) indicate that there are few ages in the exploited population, and that the age composition of the fishery is generally comparable to that observed during earlier periods. However, age 1 is not as apparent in the 1999 catch at age due to lower selection at that age. In addition, ages 7 and older are still comparatively rare. The 1997 year-class was noteworthy in both the Canada and USA fisheries. 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.

Resource Status

Canadian mobile gear **catch rates** were examined for the directed fishery in 5Zm. Catch rates have increased between 1994 and 1996, remained constant from 1996 to 1998, then increased in 1999. During discussions with industry in 1999, it was concluded that the increases in catch rates up to 1996 in this relatively new fishery probably reflected increased biomass, but were influenced by the developing skill of fishermen as well as gear development. During industry consultations in March 2000, it was noted that the increase in catch rates from 1998 to 1999 may under-represent the increase in abundance, since a significant number of fishermen did not switch to flounder gear. Industry noted that flounder gear would have higher catch rates. 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 Canadian DFO spring survey conducted in February, the USA NMFS spring survey conducted in March/April and the NMFS fall survey completed each October.



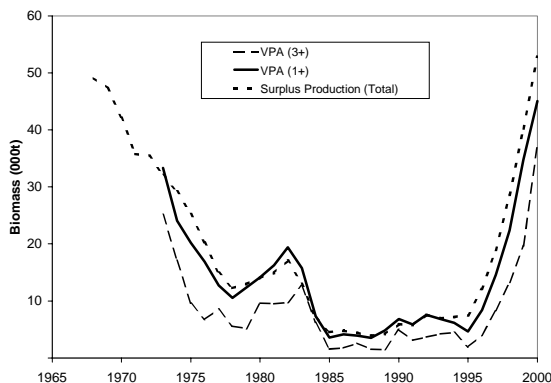
The NMFS spring survey series shows an increasing trend since 1994, and the 1999 value is the second highest in the series that starts in 1968. The NMFS fall survey series follows a similar increasing trend to the spring surveys, but the 1999 value is still less than those observed in 1960s. The mean weight per tow from the 2000 DFO spring survey continued an increasing trend which began in 1995, with the 2000 value being the highest. The area where good catches were observed during the Canadian spring survey increased from 1999 to 2000.

Information from the NMFS scallop survey (age 1 yellowtail flounder are a common by-

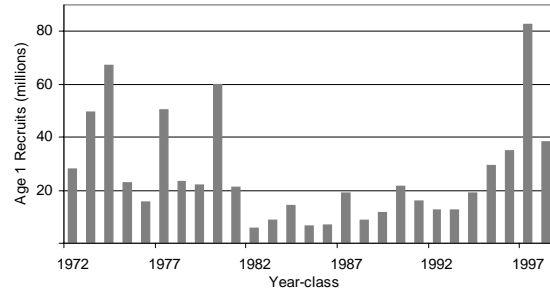
catch and are used as an index of recruitment in this assessment) support the view that recruitment during the 1990s was considerably better than that observed during the 1980s.

A virtual population analysis (VPA) was employed that incorporated indices of abundance from the USA NMFS and Canadian DFO spring surveys, the USA NMFS fall survey and the NMFS scallop survey. In light of the concerns with reconstruction of the 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 Canadian spring surveys and the NMFS fall survey, but not age composition.

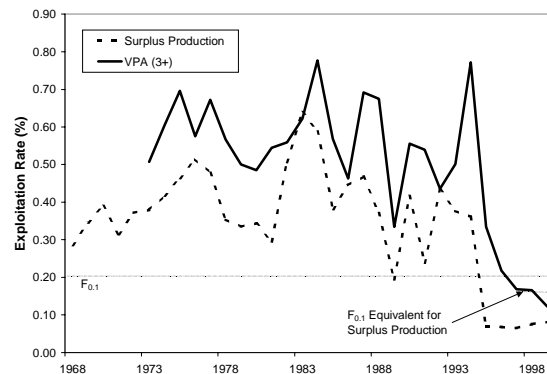
Estimates of **total biomass** (ages 1+) from both assessment models show good concurrence. Both models indicate a steady decline in total biomass from the early 1970s, an increase in the early 1980s attributable to the strong 1980 year-class, then a decrease to under 3,000 t in 1988. Total biomass has been recovering rapidly since 1995, and in 2000 was estimated as 53,400 and 44,900 t from the surplus production and VPA models, respectively. Biomass for ages 3+ (considered to reflect adult biomass) shows a similar trend and was estimated at 37,300 t at the beginning of 2000.



Recruitment estimates derived from the VPA showed that the 1997 year-class is the strongest since 1973. Adjacent year-classes are also strong relative to those observed in 1980s.

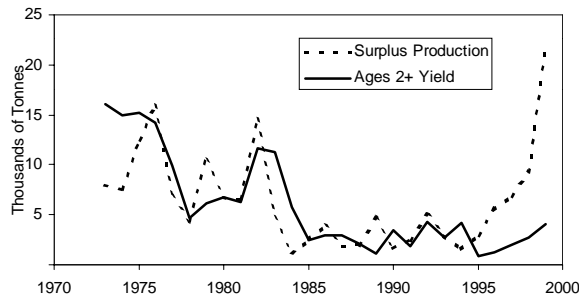


The VPA and surplus production models produce similar patterns of **exploitation rate** over time, and with respect to $F_{0.1}$ levels. For the production model, an approximation to $F_{0.1}$ was calculated, and is about 16%. The exploitation rate was well above the $F_{0.1}$ target during the 1983 to 1987 period, declined somewhat during the 1988 to 1994 period, and in 1995-1999 included the lowest values observed.



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 60% 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 surplus production was over 20,000 t.



Sources of Uncertainty

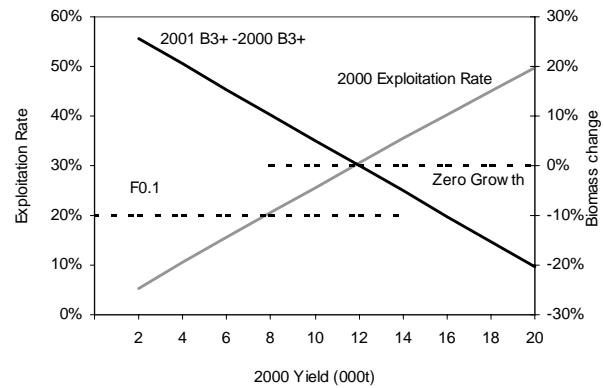
Both assessment methods are subject to significant uncertainties. For the VPA, continued low levels of sampling for the USA fishery and the absence of age information for the Canadian fishery removals have compromised the reliability of the results. This year, a retrospective pattern was noted, with 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. Statistical problems were also encountered in finding a stable solution for the production model, and the projections are not included.

Outlook

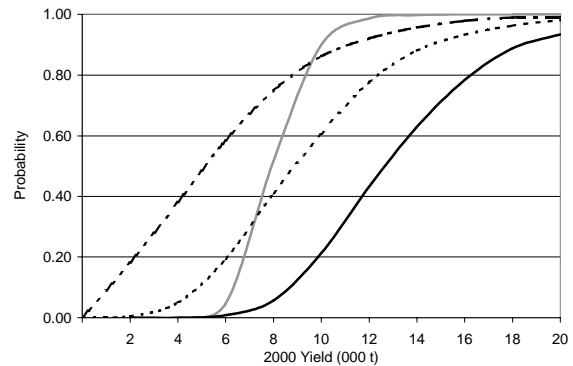
A combined Canada/USA catch of 7,800 t is implied if fished at $F_{0.1}$ in 2000. The adult biomass is expected to increase from 37,000t at the beginning of 2000 to 41,000 t by the beginning of 2001, about a 10% increase. This indicates that recent rapid

population growth is not expected to be sustained. The dominant 1997 year-class is expected to contribute about 42% of the expected yield in 2000, and comprise about 43% of the total biomass.



At a yield of 8,000 t, approximating the $F_{0.1}$ yield, there is about a 40% chance of not achieving a 10% increase in biomass from the beginning of the year 2000 to 2001.

- Exploitation rate 2000 greater than 20%
- Biomass₂₀₀₁ less than biomass₂₀₀₀
- Biomass₂₀₀₁ will not increase by 10%
- - - - Biomass₂₀₀₁ will not increase by 20%



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

In summary, the outlook for yellowtail flounder on Georges Bank continues to be

good, and the population is responding positively to the low exploitation regimes.

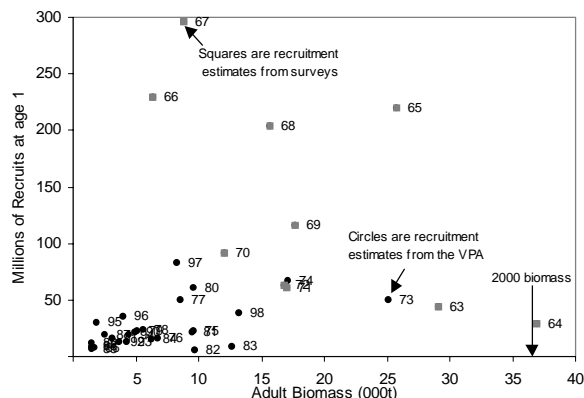
Management Considerations

The 1999 assessment indicated that with a combined Canada/USA $F_{0.1}$ catch of 4400 t in 1999, an increase in adult beginning of year biomass between 1999 and 2000 of about 50% was anticipated. The actual catch of 4,441 t in 1999 resulted in an exploitation rate of 12%, and the adult biomass at the beginning of 2000 was 37,000 t, an 89% increase in total biomass.

DFO and NMFS surveys indicate that the **proportion** 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.

Year	Percentage of biomass on Canadian side		
	Spring	Fall	
	DFO	NMFS	NMFS
1992	22	72	72
1993	64	64	82
1994	21	54	70
1995	40	71	51
1996	53	73	22
1997	25	86	49
1998	60	38	31
1999	39	48	47
2000	38		
Average	40	63	53

Adult biomass less than 7500 t has been associated with relatively low recruitment. At higher biomass, there is an increased probability of good recruitment. Few data are available to measure the magnitude and variability of recruitment at current high biomass.



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References

Cadrin, Steven X., J. Neilson, S. Gavaris and P. Perley. 2000. Stock assessment of Georges Bank yellowtail flounder for 2000. NEFSC Lab Ref. Doc. in preparation.

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