

Georges Bank Scallop

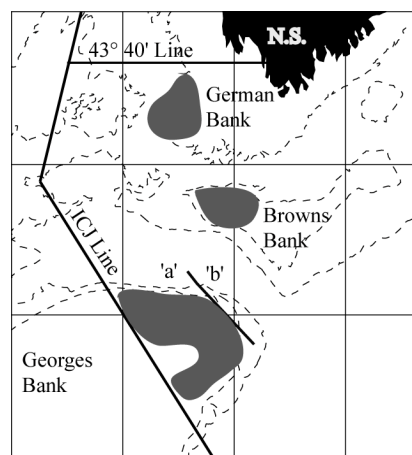
Background

The sea scallop, *Placopecten magellanicus*, is found only in the Northwest Atlantic, from Cape Hatteras to Labrador. Scallops are aggregated in patches and harvestable concentrations are called beds. Major areas of offshore fishing activity are Georges Bank, the Scotian Shelf (Middle Grounds, Sable Island Bank, Western Bank, Browns Bank, and German Bank), and St. Pierre Bank. Scallops prefer a sandy, gravel bottom and occur in depths of 35 to 120 m.

Scallops have separate sexes. They mature at age 2. The female gonad is red in colour and the male gonad colour is creamy white. The major spawning period is August to October. The fertilized eggs develop in the water column until settlement on the bottom within 30 to 60 days.

Growth is estimated from the position of annual rings on the shell. The growth rate varies from one area to another and is influenced by season, depth, and temperature.

Offshore scallop vessels range from 27 to 46 m length overall. The offshore fleet uses a New Bedford offshore scallop rake or drag, 4 to 4.9 m in width. Two drags are fished simultaneously, one on each side of the vessel.



Summary

- Georges Bank has been managed as 2 zones, 'a' and 'b', since 1998. This report deals with zone 'a'. Zone 'b' includes the deeper, less productive waters. Zone 'b' is managed with a higher meat count than zone 'a' and a rolling TAC. As long as catch rates do not decrease significantly and the meat count is met, a further quota is allowed over the next period.
- Catches and TAC's were 3,700 t (2,500 zone 'a'; 1,200 zone 'b') in 1999. The 1994 and 1995 year classes contributed over 70% to the catch.
- The total biomass estimate for 1999 is 20% larger than the previous year. The directed biomass estimate (ages 4-7) has also increased, over 25% from 1998.
- The incoming year class for the 2000 fishery is among the strongest encountered over the last 20 years. Preliminary observations show a weak year-class for the 2001 fishery.
- In zone 'a', an exploitation rate of 13% on the age groups 4-7 at the 1999 effort level would give a TAC for 2000 of 3,200 t. It would allow the biomass of ages 4-7 to increase by 21%. At an exploitation rate of 26% ($F_{0.1}$), a TAC of 6,050 t would allow the biomass of ages 4-7 to increase by 6%.

Summary of Attributes of Stock Status

This year, the stock assessment includes a compilation of attributes of stock status. Summarising these attributes in tabular form facilitates comparison and should be an aid for decisionmakers.

Attribute	Recent trend	Current Status
Biomass estimate age 3+ 1981-99	Increasing since 1995	Above average
Exploitation estimate ages 4-7 1981-99	Decreasing	Lowest observed
Commercial catch rates 1981-99	Stable	Second highest in the series
Biomass survey, ages 3-7 1981-99	Varying	Second highest in the series
Recruitment survey, age 3 1981-99	Decreasing	Above average
Survey biomass index 90-100 mm shell height 1981-99	Low	Above average
Meat weight index	Stable	Improving
Areas of high productivity	Stable	Low

The Fishery

Landings (thousands of tonnes)							
Year	70-79 Avg.	80-89 Avg.	90-95 Avg.	1996	1997	1998	1999
TAC	-	-	5.1	3.0	4.3	4.0	3.7
Catch	5.9	5.1	5.1	3.0	4.3	4.0	3.7

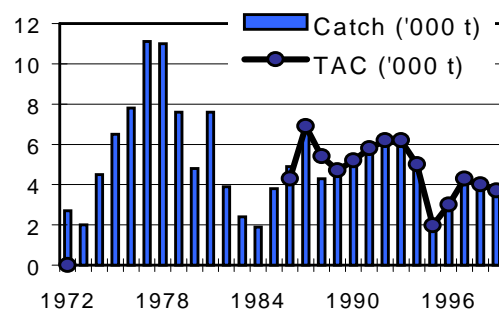
The voluntary introduction of satellite tracking on offshore scallop vessels in early 1998 has allowed micro management of fishing areas to become a reality. Under experimental management in 1998, the scallop grounds of Georges Bank were divided into the traditional area (zone ‘a’) and a marginal growth area (zone ‘b’). Zone ‘a’ continues to be managed

by a meat count set at 33 meats per 500 g. Harvest advice on zone ‘a’ only is provided in this status report.

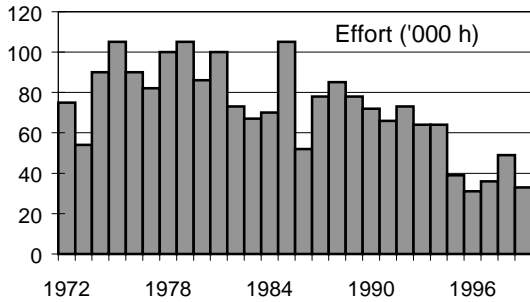
The management of zone ‘b’ included rolling TAC’s and a meat count of 50 meats per 500 g. In 1999 as in 1998, zone ‘b’ had a quota of 200t per 6-week time period. At the end of the first 6 weeks, catch rates and meat counts were such that a further 200 t was allowed over the next 6-week period. After review, the TAC rolled 6 times in 1999 for a total of 1,200 t. This approach is called a rolling TAC.

In 1995, a voluntary industry monitoring program to discourage the presence of small meats in the catch (50+ meats per 500 g) was implemented. A low tolerance level (10% by number of meats 10 g or less) added more restriction to the regulatory 33 meats per 500g.

The overall TAC for Georges Bank zones ‘a’ and ‘b’ reached 3,700 tonnes for 1999. The traditional area (zone ‘a’) TAC was 2,500 t. The absence of good to strong year classes readily available to the fishery resulted in the 1999 TAC in zone ‘a’ being 30% smaller than in 1998.



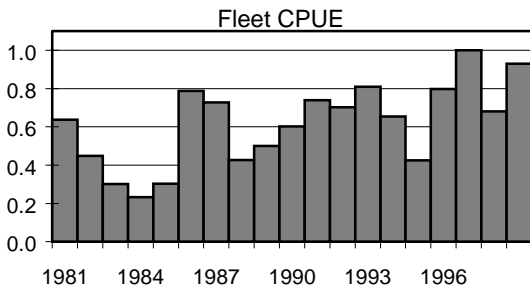
Effort in zone ‘a’ in 1999 was comparable to the 1995 to 1997 period. Satellite based monitoring data shows that the fishing activities were widely distributed over the bank from January to June and more concentrated for the remainder of the year.



The **average meat weight** in the catch from zone ‘a’ increased from 1993 to 1995. After decreasing in 1996, meat weights were in the high range again after that. The supply of very large meats was nearly exhausted by mid-year in 1999. The 1994 and 1995 year classes at ages 5 and 4 respectively made up 34 and 41% of the number of meats in the catch. Both year classes combined contributed over 70% to the catch by weight.

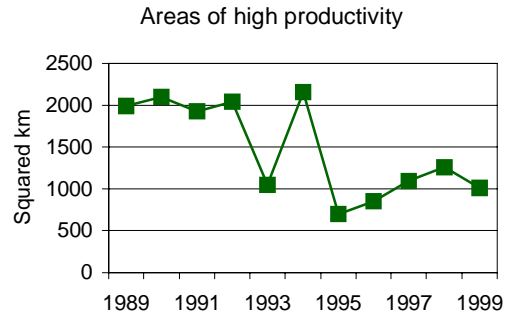
Resource Status

Logbooks provided catch and effort data from which catch rates (CPUE) were estimated. Landings are monitored at dockside. Catch in numbers at age were derived from port samples. Relative biomass indices were derived from research surveys. A Sequential Population Analysis model estimated population abundance based on commercial catch rates, research survey biomass indices, and age composition in the stock.

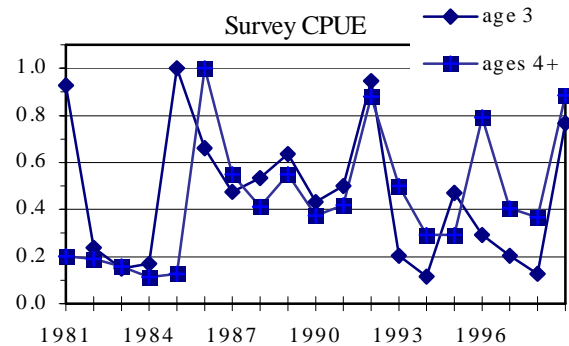


The 1999 fishery had the second highest catch rate index in the series. During the year, catch rates were low to moderate until June while the bulk of the quota was fished. After June, catch rates kept rising until the end of the year.

The **area of high productivity** is the proportion of Georges Bank maintaining catch rates greater than 1 kg/crew-hour-meter. This area has been over 1,000 km² since 1997. In the past, areas up to 2,000 km² have delivered high catch rates .

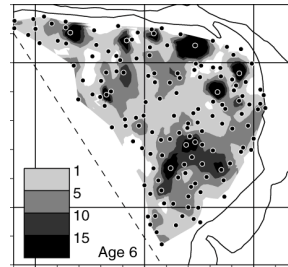
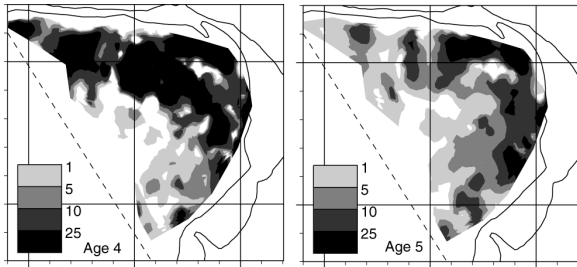


Survey catch rates of ages 3 and 4+ scallops were high in 1999. The catches of the 4+ age group were likely overestimated because of the rapid growth of age 3 scallops. The index for age 3 scallops is likely underestimated. This rapid growth was most evident in the high densities of age 3 scallops located on the northern edge of Georges Bank. This incoming year class for the 2000 fishery is among the strongest encountered over the last 20 years. Preliminary observations of age 2 scallops indicate a weak 1997 year-class. It will be recruiting to the fishery in 2001.

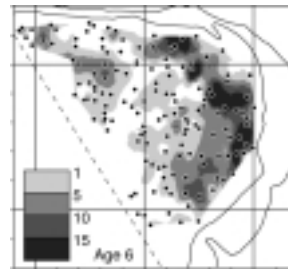
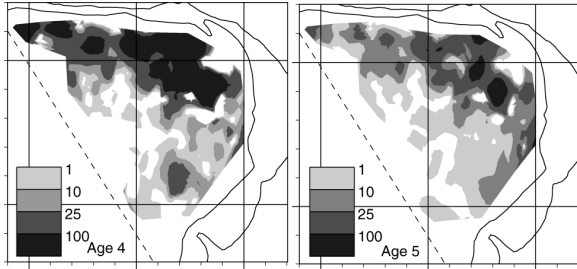


The spatial distribution of abundance at age for ages 4 to 7 from research survey data is presented in the following shaded contour plots. Survey locations are shown by dots on a map for each survey. The contour plot for age 4 in 1999 shows a wide distribution over the Canadian side of Georges Bank.

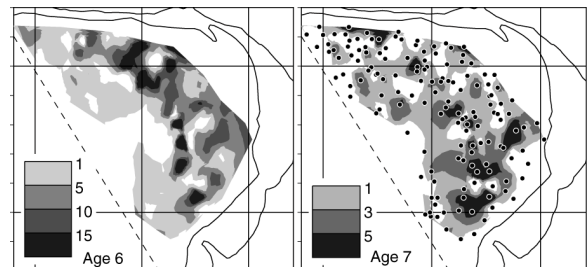
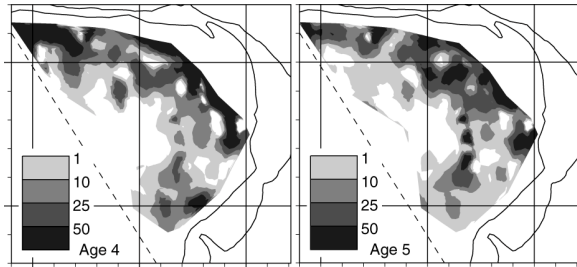
1995



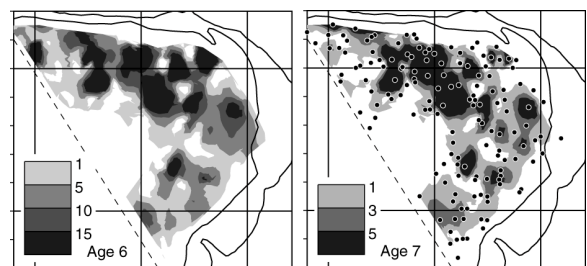
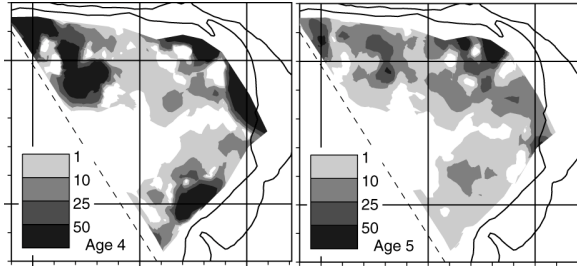
1996



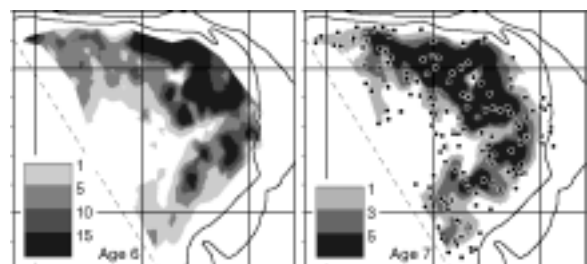
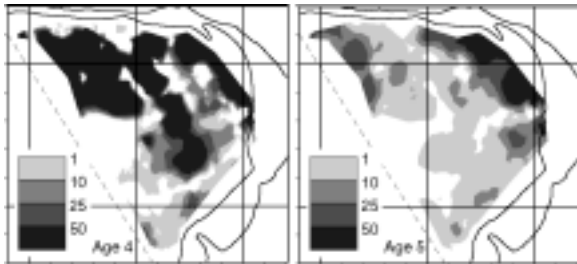
1997



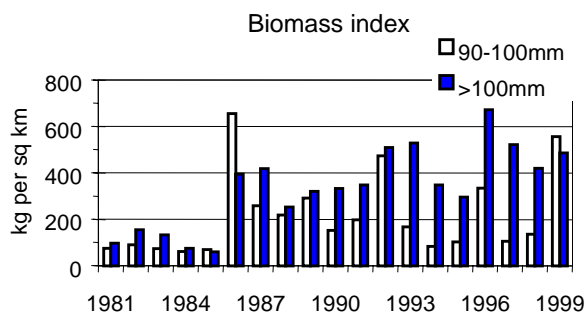
1998



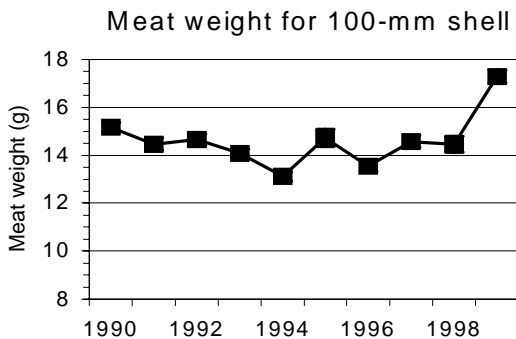
1999



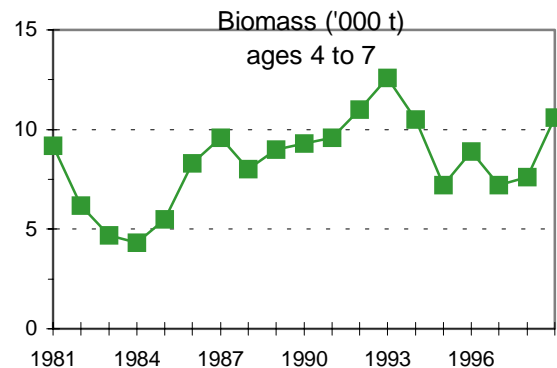
A **biomass index for shell height groupings** has been developed from research survey data for the period 1981-1999. Fully recruited indices (shell height over 100 mm) have generally been much higher after the implementation of catch limits and lower meat count in 1986. There is more volatility in the index for young recruits (shell height 90-100 mm). The index is high for 1999 suggesting a very large influx of young recruits to the 2000 fishery. The index for fully recruited scallops has remained high since 1996.



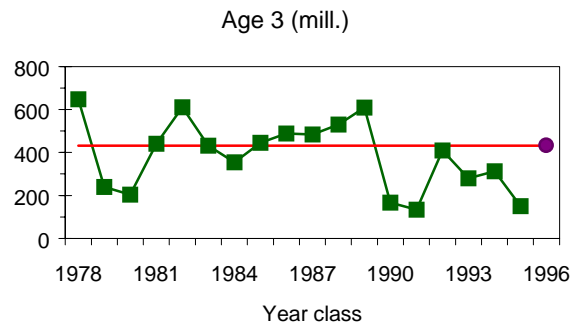
The status of the stock may also be monitored with a **meat weight index**. Large meats for a fixed shell height have not been seen on Georges Bank since at least 1990. A 14-g meat in a 100-mm scallop shell is typical of the period 1993-1998. The meat of a 100-mm scallop was 17% heavier in 1999 than in 1998. This is mainly due to the rapid growth experienced on the northern edge of Georges Bank. The increase in meat weight could partly explain the acceleration of catch rates halfway through 1999.



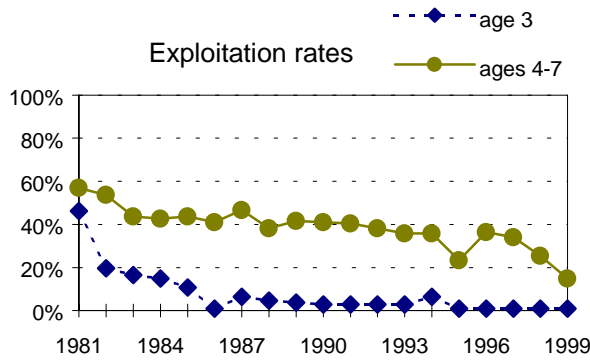
The **directed biomass** (ages 4-7) which had peaked in 1996 then dropped, is rising again and has increased 25% from 1998.



Recruitment had declined with the 1993, 1994 and 1995 year classes. The 1995 year class would appear to be well below average (horizontal line in graph below). Research survey results show a strong 1996 year class but the population model underestimated the size of the year class. This underestimation is the result of the increased growth rate causing scallops of the 1996 year class at age 3 to look like scallops at age 4 in 1999. The long-term mean was used instead (circle in graph below).



The **exploitation rate** on the directed age group had dropped below 30% in 1995 to rise again in 1996. It has declined since 1996 to reach the lowest point in 1999 at 15%. The exploitation rate on age 3 has stayed low since 1986 when the 33 meat count forced the fishery to direct for older scallops. Exploitation of age 3 scallops has been reduced to almost nil with the monitoring of small meats in the catch starting in 1995.



A production model based on shell height data from the surveys was also used. Trends in population numbers, biomass estimates, and fishing mortality rates were very similar to the Sequential Population Analysis results.

Sources of Uncertainty

The projection results carry a certain degree of **uncertainty** that is a function of how well year class strengths are estimated. There is no doubt that the 1996 year class will have a significant impact on the Georges Bank scallop stock. The extent of the impact will get better defined as the year class ages. To date, the abundance estimates rely mainly on survey observations.

The main source of uncertainty in this year’s assessment appears to be the fast growth of recent year classes.

Another source of uncertainty arises from the fact that the same age/shell height model was assumed for all years. There is spatial heterogeneity in the distribution of age groups. The fleet is targeting scallop beds because of scallop size; this will affect catch rates used in the model.

Other uncertainties include variations in weight at age, partial recruitment, variations in natural mortality, systematic errors in data reporting or model misspecifications.

Outlook

The recruitment of the strong 1996 year class into the exploitable biomass puts the Georges Bank stock in very good standing for 2000. It is anticipated to have positive impacts over the next few years and improve the outlook on the stock after years of low recruitment.

Keeping the fishing effort at the 1999 level would generate a TAC for 2000 of 3,200 t with an exploitation rate of 13% on the directed age group. The biomass of the directed age group would increase 21% during 2000 under that scenario.

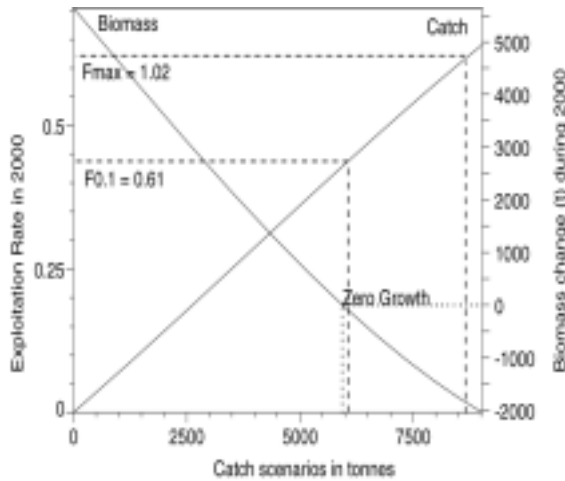
A catch scenario of 5,900 t with an exploitation rate of 43% on age 3+, 25% on the directed age group, would maintain the total biomass from the start of 2000 to the end of the year.

Catch projections at $F_{0.1}$ corresponding to an exploitation rate of 26% on the directed age group would be around 6,050 t for 2000. The total biomass would decrease by 1%. The biomass of the directed age group is projected to increase 6% at the end of 2000 under that scenario. The 1995 and 1996 year classes would represent 28% of the population estimate and 44% of the total biomass.

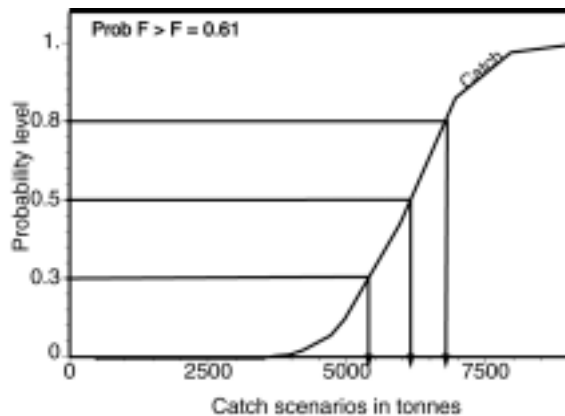
A catch scenario at F_{max} , 8,600 t, corresponds to an exploitation rate of 40% on the directed age group. The total biomass would be 16% smaller at the end of 2000 while the biomass of the directed age group would lose 11% during the year.

TAC(t)	Exploitation rate		Biomass (t)		Change in B4-7 during 2000
	age 3+	ages 4-7	End of 2000 age 3+	ages 4-7	
3,200	22%	13%	22600	17150	+21%
5,900	43%	25%	19900	15150	+7%
6,050	44%	26%	19750	15050	+6%
8,600	61%	40%	17150	12650	-11%

Other catch scenarios may be considered in the plot below.



It is possible to estimate the uncertainties from the model about stock size and use these in a risk analysis. The risk plot incorporates the difference between the model and the data. In the model used here, there is a 30% risk that a catch scenario of 5,400 t exceeds $F_{0.1}$. A catch scenario of 6,050 t has a 50% risk of exceeding the target level while 6,800 t increase the risk to 80%.



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References

Robert, G., G.A.P. Black, M.A.E. Butler, and S.J. Smith. 2000. Georges Bank scallop stock assessment - 1999. DFO Can. Stock Assess. Sec. Res. Doc. 2000/016.

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