

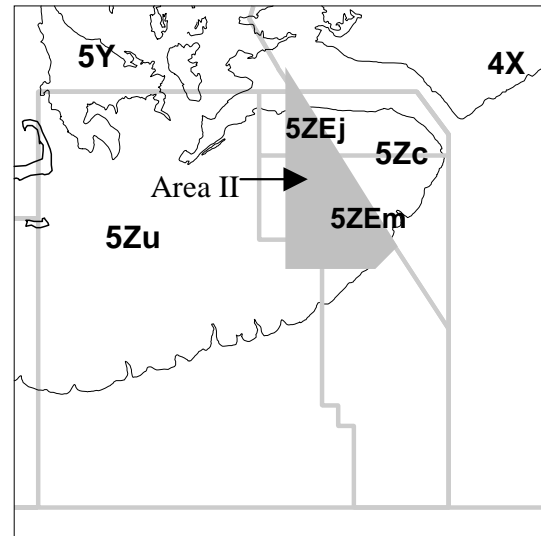
Eastern Georges Bank Haddock

Background

The haddock, a bottom dwelling species in the cod family, is found on both sides of the North Atlantic. In the western Atlantic, haddock range from Greenland to Cape Hatteras, with a major concentration on eastern Georges Bank.

Georges Bank haddock feed primarily on small invertebrates and are most commonly caught at depths of 45 to 240 meters (25 to 130 fathoms). Adult haddock appear relatively sedentary but seasonal movements occur. On Georges Bank, young haddock grow rapidly at first, reaching over 50 centimeters (20 inches) by age 3, but grow slowly after, reaching about 75 centimeters (30 inches) by age 10. Many haddock mature by age 2 but it is uncertain if these young fish spawn successfully.

Georges Bank haddock have supported a commercial fishery since prior to 1900. Bottom trawlers have been the principal gear since their introduction in the 1920s. Landings from Georges Bank, which include the eastern Georges Bank component and the Great South Channel component, averaged about 46,000t between 1935 and 1960 and increased to over 100,000t in the 1960s under heavy exploitation. Subsequently, during the early 1970s, spawning season/area closures were introduced as a means of controlling effort and are still in use today. Following the extension of jurisdiction to 200 miles by coastal states in 1977, only Canada and the USA have fished this stock. Both Canada and the USA impose minimum fish size and mesh size regulations. Additionally, Canada establishes quotas to achieve a target exploitation rate of roughly 20% or lower of the harvestable population.



Summary

- Combined Canada and USA catches in 1998 were about 3,700 t.
- Exploitation has been below $F_{0.1}$ since 1995.
- The 1992 and 1996 year-classes were moderate while the 1997 year-class was weaker. Preliminary indications suggest that the 1998 year-class will be strong.
- Biomass has increased since 1993 to near the recent average but remains only about 1/3 of the historical average.
- Growth of biomass for ages 3-8 is not expected to be strong during 1999 and the biomass will remain below the 40,000 t threshold.

The Fishery

Catches (thousands of tonnes)

Year	1970-79	1980-89	1990-94	1995	1996	1997	1998
	Avg.	Avg.	Avg.				
TAC ¹	-	-	4.3	2.5	4.5	3.2	3.9
Canada	2.7	4.4	3.8	2.1	3.6	2.6	3.4
USA	2.8 ³	4.8 ³	1.0	<0.1 ³	0.1 ³	0.1 ³	0.3 ³
TOTAL	6.1 ²	9.2 ²	4.7	2.1	3.7	2.7	3.7

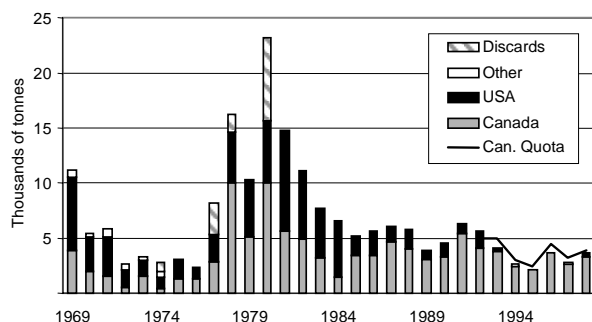
¹Canadian quota only

²Includes foreign catches

³Includes discard estimates

Under restrictive management measures, combined Canada/USA **catches** declined from over 6,400 t in 1991 to a low of about 2,100 t in 1995, then increased to about 3,700 t in 1996, 2,700 t in 1997 and 3,700 t in 1998. Greater catches in the late 1970s and early 1980s, ranging up to about 23,000 t in 1980, were associated with good recruitment. Substantial quantities of small fish were discarded in those years. Catches subsequently declined and fluctuated about 5,000 t during the mid to late 1980s.

Catches during the 1930s to 1950s ranged between 15,000 t and 40,000 t, averaging about 25,000 t. Catches probably attained record high levels of about 60,000 t during the early 1960s. Since the early 1970s catches have been substantially lower, generally fluctuating between 5,000 t and 10,000 t.



As in 1995 to 1997, **Canadian catches** in 1998 of 3,371 t were below the quota due to closure of the fisheries when the cod quotas were reached. During 1994 to 1998, all

Canadian groundfish fisheries on Georges Bank remained closed from January to early June to protect spawning.

All landings were monitored at dockside, and at-sea monitoring by observers resulted in coverage of almost 400 sea days accounting for about 10% of the cod and haddock catch. Comparison of observer samples with port samples did not reveal any persistent patterns to indicate that discarding or highgrading occurred commonly. Discarding and misreporting have been considered negligible since 1992.

In recent years, the Canadian fishery has been conducted by vessels using otter trawls, longlines, handlines and gillnets. During 1998, all vessels over 65 ft operated on enterprise allocations, otter trawlers under 65 ft and fixed gear vessels 45-65 ft operated on individual quotas while fixed gear vessels under 45 ft operated on community quotas administered by local boards. Most haddock were caught by otter trawlers less than 65 ft and longliners less than 65 ft. The catches by otter trawlers peaked in June while catches by longliners peaked in July.

USA catches for 1998 were derived from logbooks coupled with dealer reports, as was done for 1994-97. Effort in the USA fishery was regulated using closed areas and Days-at-Sea limits. To curtail targeting of haddock, a 500 lb trip limit was introduced in 1994 and raised to 1,000 lb in July 1996. The trip limit resulted in an increase in the discard rate. In September 1997, the limit was raised to 1,000 lb per day and a maximum of 10,000 lb per trip. In September 1998, the limit was further raised to 3,000 lb per day and 30,000 lb per trip. The plan for the 1999 fishing year is to establish a limit of 2,000 lb/day (maximum of 20,000 lbs/trip) beginning on May 1,

1999 which will be adjusted upward if the industry is significantly under the established target TAC. The combination of area closures, effort restrictions, and trip limits has precluded most operators from making long trips to 5Zjm, with the result that USA catches from 5Zjm have been low since 1993. While Area II remained closed in 1998, landings from 5Zjm increased to 311 t and discards declined to 14 t because the day and trip possession limits were increased.

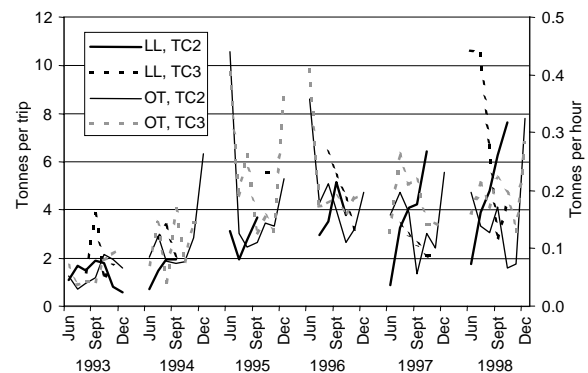
The **size and age composition** of the 1998 Canadian fishery was characterised by port and at sea samples from all principle gears and all seasons. The size composition of catch in the Canadian fisheries peaked at 53 cm (21 in) for otter trawlers and at 57 cm (22 in) for longliners. Gill-netters caught few haddock but they were larger. No sampling was available for discards of groundfish by-catch in the Canadian scallop fishery, though in previous years the amount caught has not been large. With low catches of haddock in the USA fishery, available port samples were inadequate to characterise the size and age composition of the catch, so the age composition of the Canadian otter trawler <65 ft fishery were used. Sea sampling for discards was limited but was considered appropriate to obtain the discards at age.

Over half of the 1998 catch weight was comprised of haddock from the 1992 (age 6) and 1993 (age 5) year-classes. In contrast to pre-1994, few haddock of ages 2 and 3 were caught in 1998, due in part to the type of gear used and to avoidance of areas with small fish. In comparison to the age composition of the catch during various earlier periods in this century, age groups 4-7 were well represented.

Resource Status

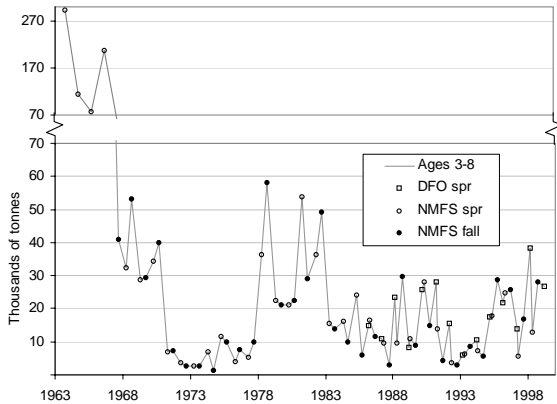
Stock status evaluations were based on an assessment using catch statistics, sampling for size and age composition of the commercial catch, and trends in abundance from three bottom trawl research surveys.

Catch rate trends from the Canadian commercial fishery for selected trips by tonnage class 2 and 3 otter trawlers and longliners showed an increasing trend from 1993 to 1995 and remained relatively stable but variable from 1996 through 1998. Otter trawl catch rates were relatively high in June of 1998 and increased again in December. Longliner catch rates for tonnage class 2 increased markedly through the 1998 season while those for tonnage class 3 decreased. Changes to regulations, gear modifications and varying fishing practices in recent years make comparison of catch rates from year to year difficult to interpret. Therefore, these were not used as indices of abundance.

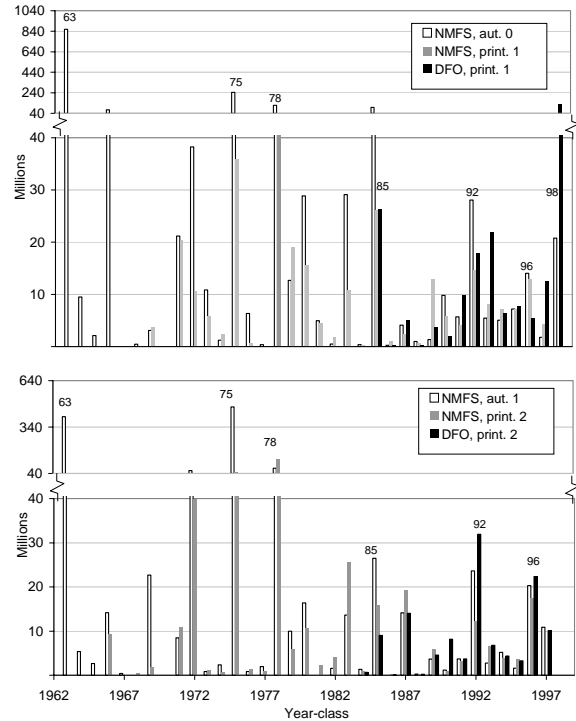


Surveys of Georges Bank have been conducted by the USA National Marine Fisheries Service (NMFS) each fall since 1963 and each spring since 1968, and by Canada's Department of Fisheries and Oceans (DFO) each spring since 1986. The distribution of catches for the most recent surveys of each series was similar to the distribution over the previous 5 year period.

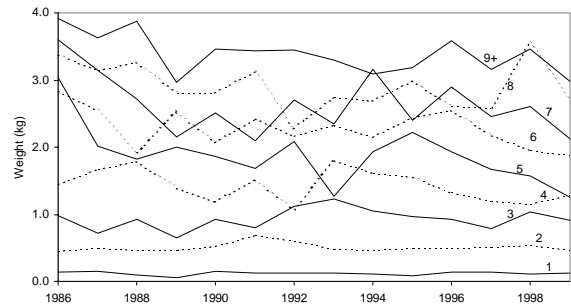
The trend in ages 3-8 abundance from surveys increased from 1992 to 1996 and has fluctuated since then. Abundance peaked at record highs during the early 1960s. After declining to a record low in the early 1970s, it peaked again in the late 1970s, though at a lower level, and again during the mid to late 1980s at about half the level of the 1970s peak.



Survey results for ages 1 and 2 indicate that the abundance of the 1996 year-class may be comparable to the moderate 1983, 1985, 1987 and 1992 year-classes. These year-classes were considerably smaller than the strong 1975 and 1978 year-classes and the very strong 1962 and exceptional 1963 year-classes. The 1997 year-class is weaker but first indications for the 1998 year-class suggest it may be moderate to strong.

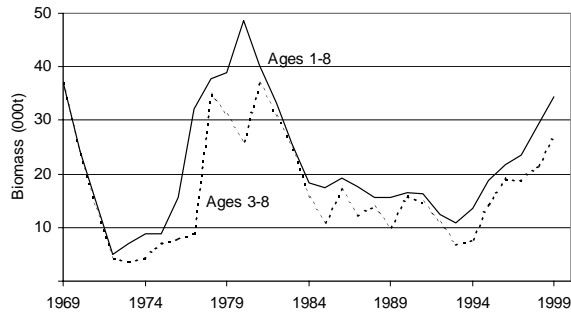


Average weight at age of haddock from the 1989 to 1991 year-classes were higher than adjacent year-classes in both the commercial fisheries and the surveys, giving the false impression of a declining trend in recent years.

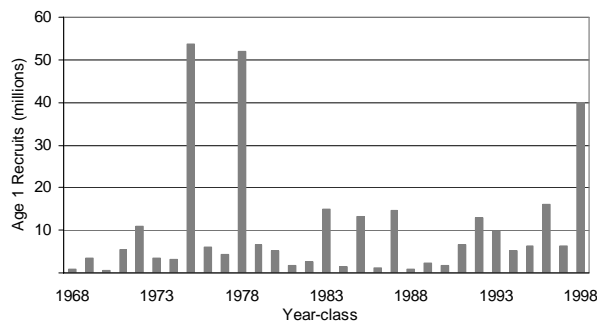


Population biomass (ages 1-8) has steadily increased from near historic low levels of about 11,000 t in 1993 to over 30,000 t at the beginning of 1999. The recent increase, due principally to the 1992 year-class, but also supported by the 1991 and 1993 year-classes, was enhanced by increased survivorship of young haddock from reduced capture of small fish in the

fisheries. The continuing increase is being sustained by the 1996 year-class. The biomass trend for ages 3-8 is similar with a 24% increase from 1998 to 1999, based on the current perception of trend, due largely to recruitment of the 1996 year-class.



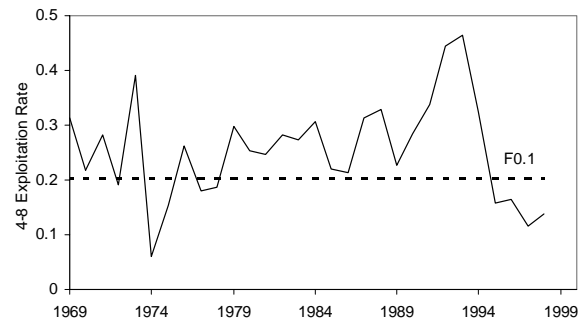
The strength of the 1996 year-class was estimated to be about 16 million at age 1, comparable to the 1983, 1985, 1987 and 1992 year-classes, while those during 1988-90 were less than 3 million. The 1991 and 1993 year-classes were estimated at about 7 and 10 million respectively while the incoming 1995 and 1997 year-classes appear to be relatively weak at about 6 million. Preliminary indications for the 1998 year-class indicate that it may be strong at up to about 40 million recruits.



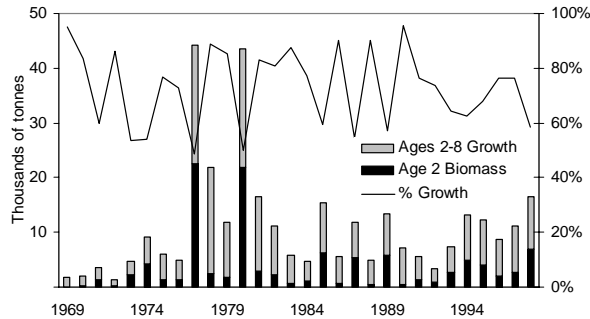
Population biomass during the late 1970s and early 1980s was considerably higher, ranging to almost 50,000 t, due to recruitment of the strong 1975 and 1978 year-classes whose abundance was estimated at about 50 million. However,

biomass declined rapidly in the early 1980s as subsequent recruitment was poor and these two year-classes were fished intensely at a young age.

Exploitation rate for fully recruited ages 4-8 has consistently been below $F_{0.1}$ of 20% ($F_{0.1} = 0.25$) since 1995. Historically, exploitation rate has generally exceeded $F_{0.1}$ and showed a marked increase between 1989 and 1993 to over 50%, the highest level observed. Reduced fishing mortality in recent years has resulted in increased survival of incoming year-classes. The number of haddock of the 1992 year-class surviving to age 6 was about three times that of the equally abundant 1983 year-class, and about the same as that of the 1975 or 1978 year-classes which were more than 3 times as abundant.



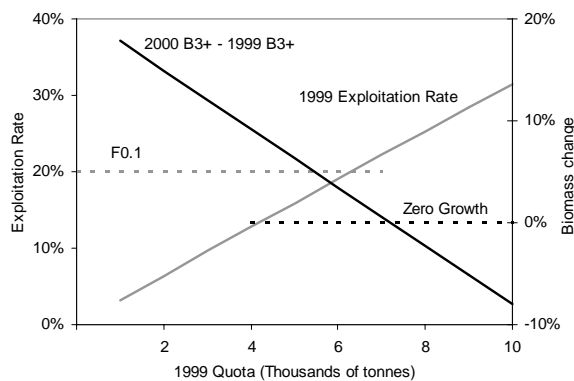
In both absolute numbers and percent composition, the population structure displays a broad representation of age groups, reflecting improved recruitment and lower exploitation. Since 1993, biomass gains from growth and from recruitment have exceeded the losses due to natural deaths and to fishery harvest, resulting in net increase. Growth of fish is the dominant component of the biomass gain but recruitment accounts for significant portions when stronger year-classes enter.



Results from assessments for several other stocks have identified a discrepancy between past estimates of stock status and current estimates using additional data (retrospective pattern). Results for this stock indicate that this assessment does not suffer from a retrospective pattern.

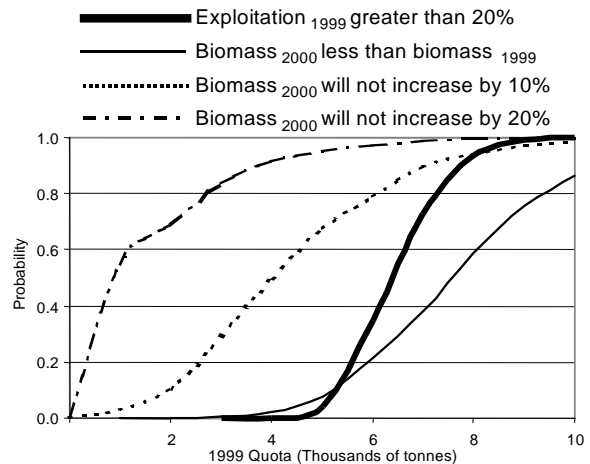
Outlook

Projected total Canada/USA yield at $F_{0.1}$ = 0.25 in 1999 would be about 6,300 t. If fished at $F_{0.1}$ in 1999, the biomass for ages 3-8 is projected to increase from 26,836 t to 27,430 t by the beginning of 2000. Ages 3 to 7 should comprise about 90% of the total yield in 1999, with all these year-classes contributing almost equally.



Uncertainty about year-class abundance generates uncertainty in forecast results. This uncertainty was expressed as risk of achieving reference targets. For example, a combined Canada/USA catch of 4,000 t in

1999, about what was caught in 1998, results in a very low risk that fishing mortality rate will exceed $F_{0.1}$ and that the biomass for ages 3-8 will decrease. At this yield there is a risk of about 50% of not achieving 10% biomass increase and a risk of over 90% of not achieving 20% biomass increase.



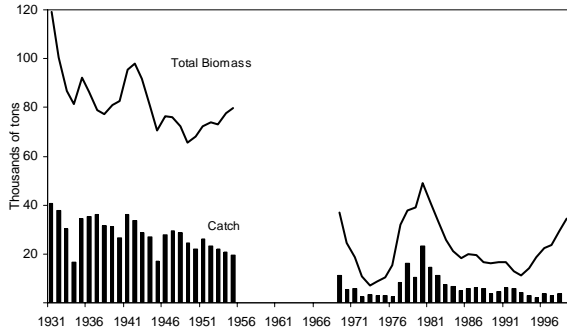
These uncertainty calculations **do not include** variations in weight at age, partial recruitment to the fishery and natural mortality, or systematic errors in data reporting and model mismatch. Therefore, overall uncertainty would be greater, but these results provide guidelines.

Management Considerations

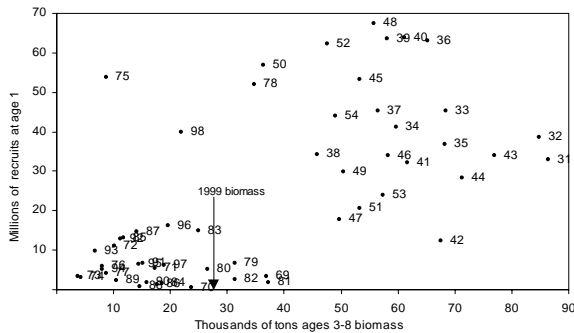
A Canadian quota of 3,900 t in 1998 was expected to result in a negligible chance of exceeding $F_{0.1}$ and an 80% chance of getting 20% growth in the stock. The Canadian catch in 1998 was about 3,400 t and resulted in a fishing mortality about 65% of $F_{0.1}$ and an increase in ages 3-8 biomass of about 24%.

Data were available to approximate the age composition of the catch from unit areas 5Zj and 5Zm in order to reconstruct an illustrative population analysis for the

period between 1930 and 1955 which is suitable for comparing productivity. The results indicated that the current total biomass was less than a third of the average sustained over those two decades.



The pattern of recruitment against adult biomass indicates that the chance of a strong year-class is significantly reduced for biomass below about 40,000 t. Since 1969, only the 1975 and 1978 (and possibly the 1998) year-classes have been near the average abundance of year-classes observed during that historic period.



Examination of the recruits per spawning biomass ratio suggests that egg/larval survivorship for several years during the 1980s may have been lower than the norm. The present survivorship appears comparable to that of the 1930s to 1950s period, supporting the expectation that higher recruitment might result if the biomass increases.

The percent of biomass, ages 3-8, on the Canadian side of 5Zjm from the three surveys was summarised for recent years. During the NMFS fall surveys, almost all of the biomass occurred on the Canadian side. During the DFO spring surveys, generally conducted in late February, most of the biomass was on the Canadian side although the percentage was lower in 1992-93. During the NMFS spring surveys, generally conducted in late March, the percentage on the Canadian side was typically lower but these results were more variable.

Percentage of biomass on Canadian side

Year	Spring		Fall
	DFO	NMFS	NMFS
1992	68	78	100
1993	67	43	99
1994	99	100	100
1995	98	62	100
1996	96	17	100
1997	92	93	100
1998	100	78	100
1999	98	N/A	N/A

Cod and haddock are often caught together in groundfish fisheries. However, their catchabilities to the fisheries differ and they are not necessarily caught in proportion to their relative abundance. This may compromise the joint achievement of objectives.

For more Information

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This report is available from the:

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Internet address: www.dfo-mpo.gc.ca/csas
ISSN: 1480-4913

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***Correct citation for this publication***

DFO, 1999. Eastern Georges Bank Haddock.
DFO Science Stock Status Report A3-
08(1999).