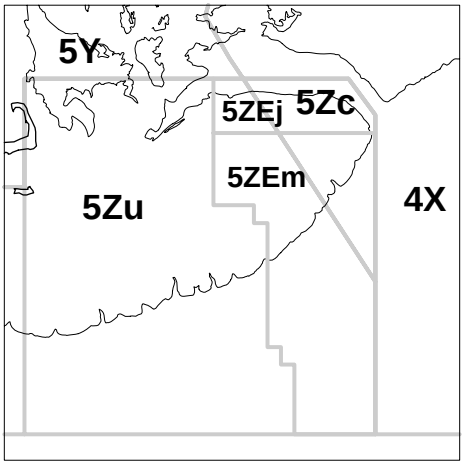
EASTERN GEORGES BANK HADDOCK



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 with a target exploitation rate of roughly 20% of the harvestable population.

Summary

- Under restrictive management measures, combined Canada/USA catches declined from 6,377 t in 1991 to a low of 2,111 t in 1995, but increased again to 3,720 t and 2,850 t in 1996 and 1997 respectively.
- Total population biomass (ages 1+) has steadily increased from near historic low levels of 12,171 t in 1993 to 28,809 t in 1998.
- 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.
- Exploitation rate for ages 4 and older has consistently been below the $F_{0.1}$ target of 20% ($F_{0.1}$ = 0.25) since 1995.
- Combined Canada/USA projected yield at $F_{0.1}$ = 0.25 in 1998 would be about 6,000 t.
- If fished at $F_{0.1}$ in 1998, the biomass for ages 3 and older is projected to increase from 22,726 t to 28,012 t by the beginning of 1999.

The Fishery

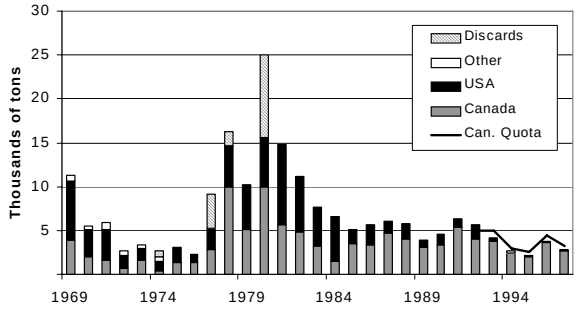
Landings (thousands of tons)

Year	1970-79 Avg.	1980-89 Avg.	1990-93 Avg.	1994	1995	1996	1997
TAC[1]	-	-	5.0	3.0	2.5	4.5	3.2
Canada	2.7	4.4	4.1	2.4	2.0	3.7	2.8
USA	2.8[3]	4.8[3]	1.0	0.3[3]	<0.1[3]	0.1[3]	0.1[3]
TOTAL	6.1[2]	9.2[2]	5.2	2.7	2.1	3.7	2.9

[1]Canadian quota only
[2]Includes foreign catches
[3]Includes discard estimates

Under restrictive management measures, combined Canada/USA **catches** declined from 6,377 t in 1991 to a low of 2,111 t in 1995, but increased again to 3,720 t and 2,850 t in 1996 and 1997 respectively. Greater catches in the late 1970s and early 1980s, ranging up to 23,189 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 but since the early 1970s catches have been lower.



As in 1995 and 1996, **Canadian catches** in 1997 of 2,739 t were below the quota due to closure of the fisheries when the cod quotas were reached. During 1994 to 1997, all Canadian groundfish fisheries on Georges Bank remained closed from January to early June. Although the number of vessels fishing with fixed gear declined in 1997, the number of vessels fishing with mobile gear and the total number of days fished by all fishing sectors was about the same as in 1996. All landings were monitored at dockside, and at-sea monitoring by observers resulted in coverage of almost 10% of days fished. Samples collected by surveillance officers were also examined and did not reveal any persistent patterns to indicate that discarding or high grading 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 1997, all vessels over 65 ft operated on enterprise allocations, otter trawlers under 65 ft operated on individual quotas, fixed gear vessels 45-65 ft operated on self-administered individual quotas and 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. Unlike recent years, catches in June were not very high but the fishery improved in July.

USA catches for 1997 were derived from logbooks coupled with dealer reports, as was done for 1994-96. Catches in 1997 remained low because Area II was closed to fishing during the entire year. Effort in the USA fishery was regulated using 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. USA discards for 1994-1997 were estimated from dealer data and vessel trip reports at 258 t, 25 t, 41 t and 63 t respectively.

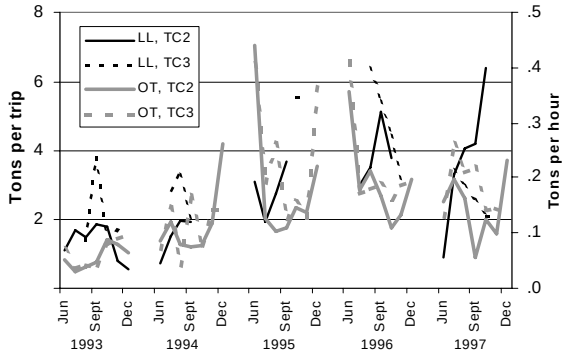
The **size and age composition** of the 1997 Canadian fishery was characterized by port and at sea samples from all principle gears and all seasons. The size composition of catch in the Canadian fisheries for otter trawlers and longliners was similar, peaking at about 22in. Gillnetters caught few haddock 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 decreasing landings of haddock in the USA fishery, few port samples were available to characterize the size and age composition of the landings. Sea sampling for discards was limited and current reporting rates in vessel trip reports (logbooks) are inadequate to reliably estimate the quantity of haddock discards.

About 70% of the 1997 catch weight was comprised of haddock from the 1992 and 1993 year-classes. Their average lengths were 22.5in and 21in respectively. In contrast to pre-1994, few haddock of ages 2 and 3 were caught in 1997, 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 earlier periods, age groups 4-6 and 9+ 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 (USA spring and fall and Canadian spring).

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 through 1996 and 1997. In contrast to 1995 and 1996, otter trawl catch rates were relatively low in June of 1997 but displayed the expected increase in December. Longliner catch rates for tonnage class 2 increased markedly through the 1997 season. 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.

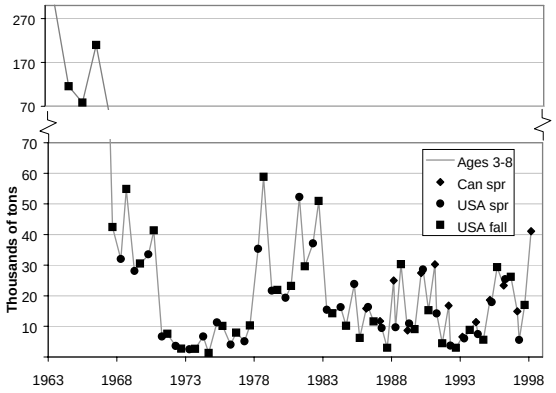


Surveys have been conducted by the USA National Marine Fisheries Service (NMFS) each fall since 1963 and each spring since 1968, and by Canada (DFO) each spring since 1986. The distribution of catches for the most recent surveys of each series was similar to the distribution over the previous 5 year period. The percent of biomass, ages 3-8, on the Canadian side of 5Zjm from the three surveys was summarized for the most recent years. During the NMFS fall survey, almost all of the biomass occurred on the Canadian side. During the DFO spring survey, 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 survey, generally conducted in late March, the percentage on the Canadian side was typically lower but these results were more variable.

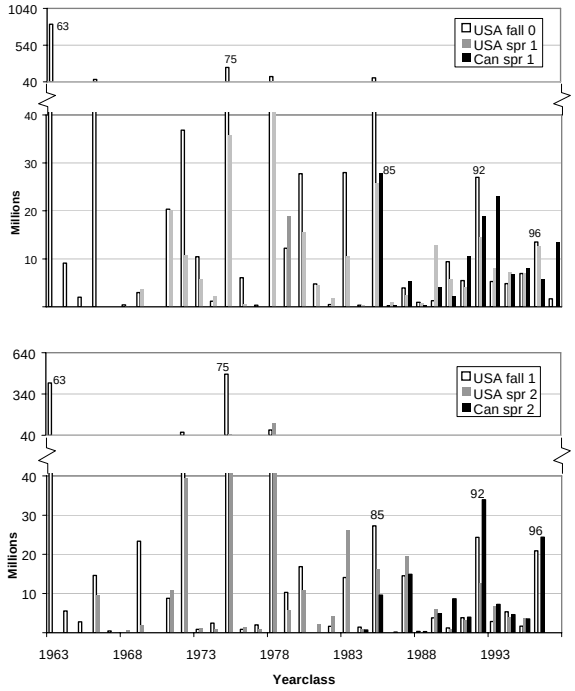
Percentage of biomass on Canadian side

	Spring		Fall
Year	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	N/A	N/A

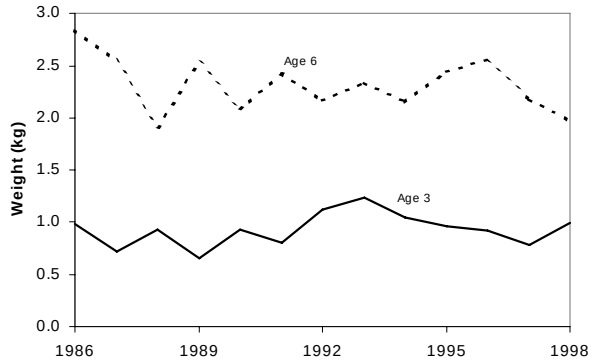
The trend in ages 3-8 **abundance** from surveys increased from 1992 to 1995 and has fluctuated since then with no persistent pattern. Abundance peaked at record highs during the early 1960s. After declining to a record low in the early 1970s, it peaked again in the late 1970s, though at a lower level, 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.

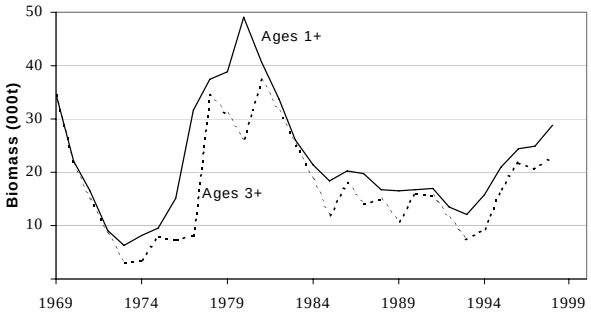


With the exception of the higher than average **weight at age** for the 1989 and 1990 year-classes, average weight at age from surveys in recent years did not display persistent trends.

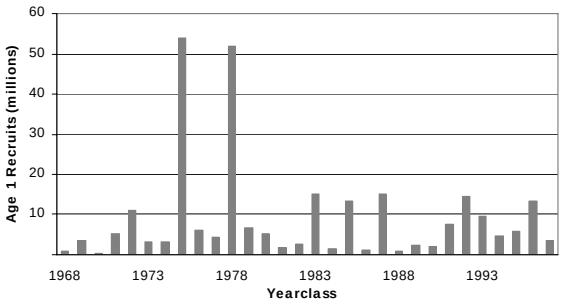


Total population biomass (ages 1+) has steadily increased from near historic low levels of 12,171 t in 1993 to 28,809 t in 1998. The recent increase, due principally to the 1992 year-class, but also supported by the 1991 and 1993 year-classes, was enhanced by increased survivorship of young haddock from 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 and older is similar.

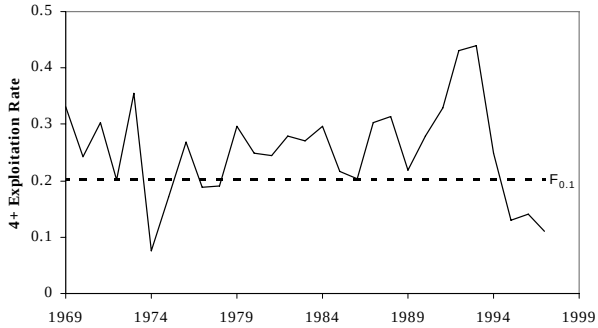


The strength of the 1996 year-class was estimated to be about 13 million, comparable to the 1983, 1985, 1987 and 1992 year-classes, while those during 1988-90 were less than 3 million. The 1991 and 1993 year-classes were estimated at about 7 and 10 million respectively while the incoming 1995 and 1997 year-classes appear to be relatively weak at about 6 and 3 million respectively.



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.

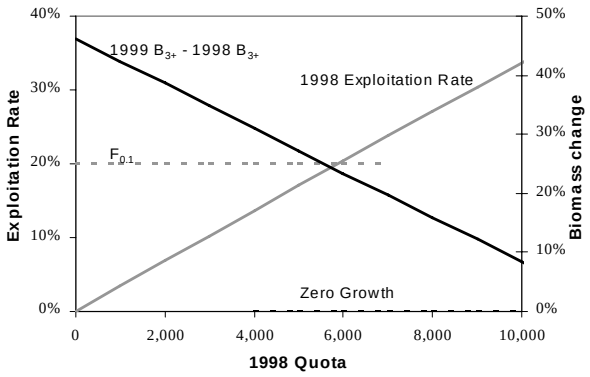
Exploitation rate for ages 4 and older has consistently been below the $F_{0.1}$ target of 20% ($F_{0.1}$ = 0.25) since 1995. Historically, exploitation rate has generally exceeded $F_{0.1}$ and showed a marked increase between 1989 and 1992 to almost 50%, the highest level observed. Reduced fishing mortality in recent years has resulted in increased survival of incoming year-classes. The number of haddock surviving to age 6 of the 1992 year-class was about twice 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.



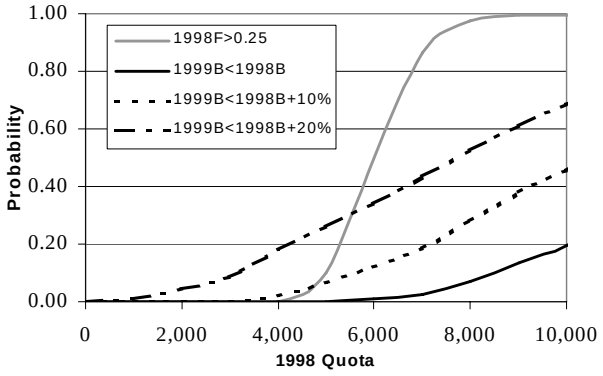
Results from assessments for several other stocks have identified a discrepancy between past estimates of stock status and current estimates using additional data (retrospective pattern). Results for this stock indicate that this assessment does not suffer from a retrospective pattern.

Outlook

Combined Canada/USA projected yield at $F_{0.1}$ = 0.25 in 1998 would be about 6,000 t. If fished at $F_{0.1}$ in 1998, the biomass for ages 3 and older is projected to increase from 22,726 t to 28,012 t by the beginning of 1999. The 1992 and 1993 year-classes would comprise about 40% of the age 3+ biomass and 60% of the forecast yield. The 1996 year-class contributes almost 30% to the 1999 age 3+ biomass.



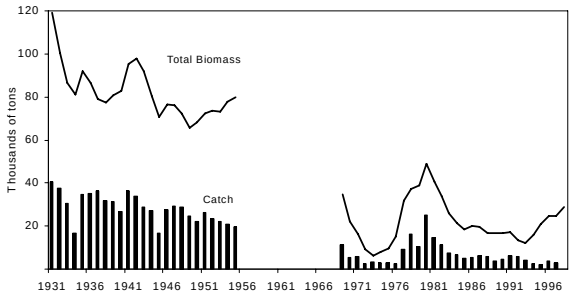
Uncertainty about year-class abundance generates uncertainty in forecast results. This uncertainty was expressed as risk of achieving reference targets. For example, a combined Canada/USA catch of 3,000 t in 1998, about what was caught in 1997, results in a negligible risk that fishing mortality rate will exceed $F_{0.1}$ and that the biomass for ages 3 and older will decrease. That same yield gives risks of 0% and 10% that an increase in biomass of 10% and 20% respectively would not be achieved.



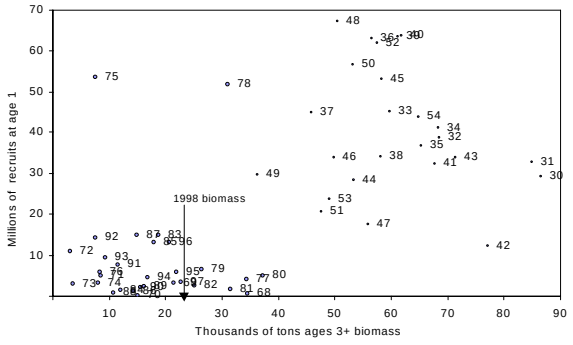
These uncertainty calculations do not include variations in weight at age, partial recruitment to the fishery and natural mortality, or systematic errors in data reporting and model mismatch. Preliminary exploration of the impact of model mismatch indicated that it could be significant and requires further investigation. Therefore, overall uncertainty would be greater, but these results provide guidelines.

Management Considerations

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 observing a strong year-class is significantly worse for biomass below about 40,000 t. Since 1969, only the 1975 and 1978 year-classes have been near the average abundance of year-classes observed during that historic period.

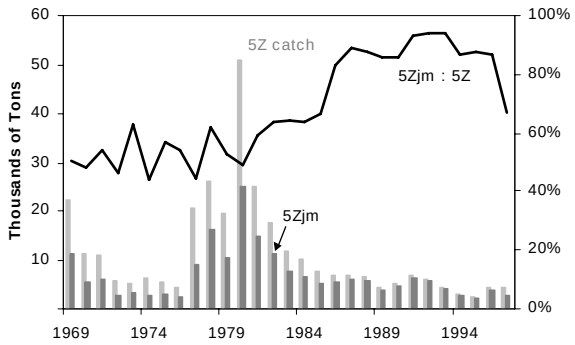


Comparison of Results for Canadian and USA Management Units

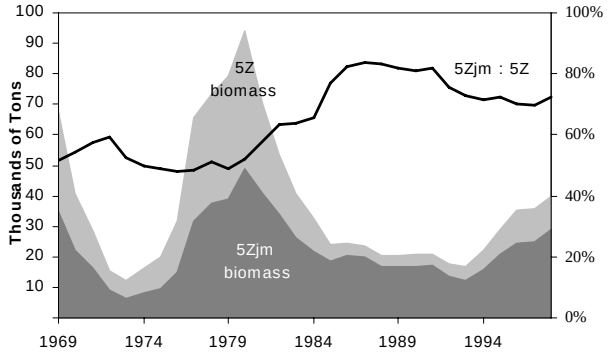
The existence of two centers of haddock aggregation on Georges Bank with distinct spawning components has long been recognized. One aggregation spawns on the Northeast Peak in the spring and migrates to the bank slopes on the Northeast Edge and Peak as the waters warm in the summer. The other component spawns around the Nantucket Shoals in the spring and migrates to the bank slopes around the Great South Channel as the waters warm in the summer. The former is referred to as the Eastern component and the latter as the Western component. There is evidence for limited but poorly quantified exchange between the two components. Haddock from the Western component are characterized by faster growth.

The USA conducts fisheries for haddock on both the Western and Eastern components. The USA defines a management unit encompassing both Eastern and Western components of the Georges Bank haddock resource, specifically NAFO Division 5Z (small amounts of haddock caught in NAFO Subarea 6 are included). Canada conducts fisheries for haddock on the Eastern component only and is concerned with regulatory measures which could be applied to it in order to achieve benefits. Accordingly, Canada defines unit areas 5Zj and 5Zm as a management unit.

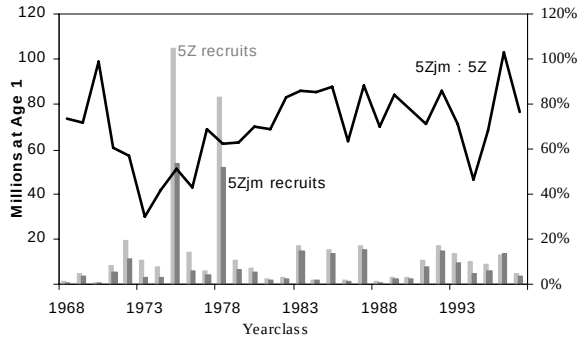
Between 1969 and 1985, catches from 5Zjm averaged about 56% of the total catches from 5Z, ranging between 44% and 67%. During 1985 to 1996, catches from 5Zjm were consistently above 83% of the total catches from 5Z, averaging about 88%, but in 1997 that percentage dropped to 67%.



Over this period, the total biomass for the two management units showed a similar pattern. The biomass in 5Z declined from 94,000 t in 1980 to 17,000 t in 1993 and has since increased to 40,000 t in 1998. In 5Zjm, the biomass declined from 49,000 t in 1980 to 12,000 t in 1993 and has reached about 29,000 t in 1998. Since 1985, the biomass in 5Zjm has consistently been over about 70% of the total 5Z biomass.

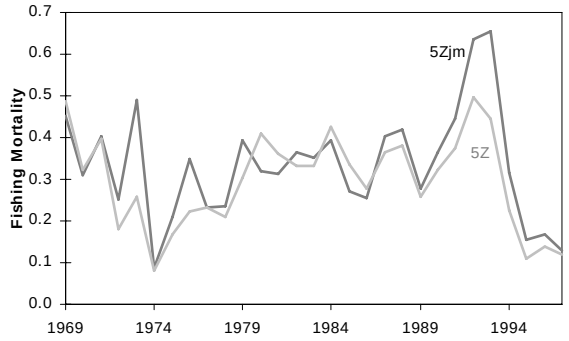


The 1975 and 1978 year-classes were the most abundant on Georges Bank since 1969. The abundance at age 1 for these two year-classes was about 105 million and 83 million respectively for all of 5Z and about 54 million and 52 million in 5Zjm. Subsequent year-classes have been considerably weaker with the strongest among them being the 1983, 1985, 1987, 1992 and 1996 year-classes. The abundance at age 1 of these year-classes was 17,15,17, 17 and 13 million respectively for all of 5Z and 15,13,15, 14 and 13 million in 5Zjm.



The 1968 through 1980 year-classes in 5Zjm averaged about 60% of the abundance for all of 5Z while those after 1980, with the exception of 1994 and 1995, have generally comprised over 70% of the total for 5Z, averaging about 80%.

The fishing mortality rates in 5Zjm and in all of 5Z showed a decline between the early and mid 1970s, followed by an increase until 1980. Between 1980 and 1990, the fishing mortality rate fluctuated between about 0.3 and 0.4. It then increased rapidly to about 0.45 in 5Z and 0.65 in 5Zjm by 1993 and subsequently declined to below 0.2 in both 5Zjm and 5Z by 1995.



Between 1969 and 1985, the contribution to production by the Eastern and Western components was roughly equivalent, and both components appeared to have been exploited to the same degree. Since 1985 however, over 80% of the production on Georges Bank was attributed to the Eastern component. By 1997, the Eastern component increased to almost half of its biomass level observed during the late 1970s and early 1980s while Georges Bank as a whole only increased to about a third of its respective biomass level. There is some evidence that the production from the Western component is improving over the last few years. The 1994 and 1995 year-classes were estimated to be about equally represented in both components however, the 1996 year-class is poorly represented in the Western component.

For more Information:

Contact: Stratis Gavaris or
Lou Van Eeckhaute
Marine Fish Division
Biological Station
St. Andrews, NB
E0G 2X0

Tel: (506)529-5912
Fax: (506)529-5862
E-Mail:
GavarisS@mar.dfo-mpo.gc.ca
or
Van-EeckhauteL@mar.dfo-mpo.gc.ca

References

Gavaris, S., and L. Van Eeckhaute. 1998. Assessment of haddock on eastern Georges Bank. DFO Canadian Stock Assessment Secretariat Res. Doc. 98/66.

This report is available from the:

Maritimes Regional Advisory Process
Department of Fisheries and Oceans
P.O. Box 1006, Stn. B105
Dartmouth, Nova Scotia
Canada B2Y 4A2
Phone number: 902-426-7070
e-mail address: myrav@mar.dfo-mpo.gc.ca

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

La version française est disponible à l'adresse ci-dessus.

Correct citation for this publication

DFO, 1998. Eastern Georges Bank Haddock. DFO Sci. Stock Status Rep. A3-08 (1998).