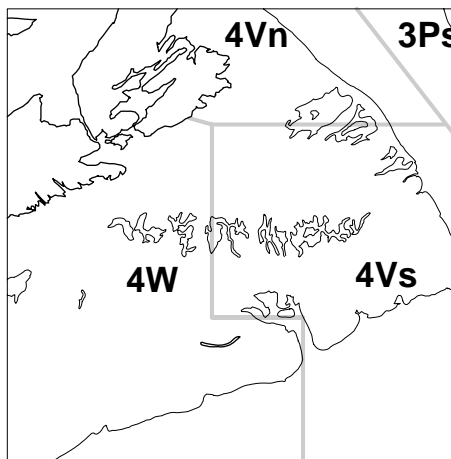




**EASTERN SCOTIAN SHELF
HADDOCK**



Background

Haddock on the eastern Scotian Shelf and southern Gulf of St. Lawrence are considered as a single management unit distinct from adjacent populations on the southern Scotian Shelf (Division 4X) and across the Laurentian Channel (Division 3P).

The majority of 4TVW haddock occur on the complex of offshore banks ranging from Emerald Bank in the west to Banquereau Bank in the east. Significant concentrations of haddock did occur inshore of these banks and in the Gulf of St. Lawrence; however, in recent years these more inshore components have become rare. Historically it was considered that haddock from the offshore banks migrated to inshore waters during the summer, moved east along the shore of eastern Nova Scotia and Cape Breton and then entered the Gulf of St. Lawrence. In the fall this migration was reversed. It is unclear whether or not this migratory pattern still occurs because there are now so few haddock found in these inshore waters. None of almost 15,000 tags applied to haddock on Emerald, Western, and Banquereau banks in the late 1980s were recovered from inshore waters.

Haddock prefer hard sand or gravel bottoms at depths ranging from less than 50 m to about 350 m, and temperatures ranging from 4-8°C. During the summer, haddock congregate on the tops and upper slopes of banks, while in the winter months, when the water on the banks cools, they move to deeper warmer waters in the gullies between banks and the slopes of the continental shelf. During the spring (March-April), haddock once again move up on the banks (mainly Emerald and Western banks) to spawn in dense aggregations. These spawning aggregations formed the target of intense fisheries until the imposition of a closed area encompassing Emerald and parts of Western banks in 1987.

A mature female can produce several hundred thousand eggs depending on her size. The eggs are very small, and although released near bottom, float in the water. The eggs hatch in anywhere from 9 days to a month depending on water temperatures, hatching is slower at colder temperatures. Newly hatched haddock are only 3 or 4 mm (1/10 of an inch) long but grow to about 80 mm (3 inches) by the end of their first summer. During the first few months of life the young haddock live off bottom and are often associated with jellyfish. They become bottom dwellers at about 50 mm (2 inches). It is difficult to determine the age of a haddock from the eastern Scotian Shelf. The pattern of rings in their otoliths (earbones), particularly in larger fish, is complex and difficult to interpret. This also makes it difficult to determine the growth rates of these fish. There is however some evidence that growth varies with area, overall size of the haddock population, and environmental conditions.

Adult haddock are bottom feeders and forage on some 200 different species of bottom dwelling invertebrates and small fishes, including: brittle stars and other echinoderms (starfish like animals), worms, and sand lance. Haddock themselves are eaten by cod, pollock and white hake.

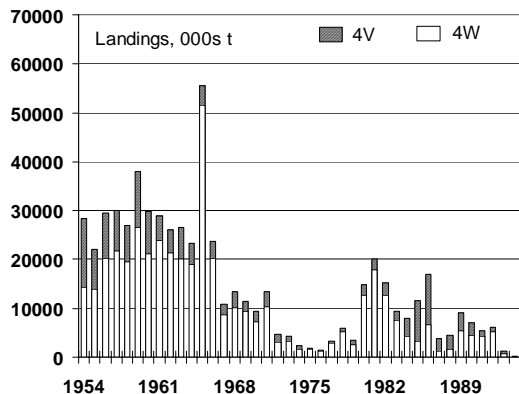
The Fishery

Landings (thousands of tonnes)

Year	70-79 Avg.	80-89 Avg.	1991	1992	1993	1994	1995
TAC			_*	_*	_*	_*	_*
Reported	5.0	11.4	5.4	6.1	1.2	0.1	0.1
Landings							

* - By-catch only

Annual landings averaged 26,500t from 1950 to 1969, 5,000t from 1970 to 1979, and ranged between 8,000 and 20,000t until 1987. The nominal catches for 1987 through 1994, have been taken almost exclusively as by-catch in other groundfish fisheries operating in divisions 4T, 4V and 4W, and totalled just under 120t in 1995.



The year-round **nursery ground closure** (mainly Emerald and Western banks) imposed in 1987 remains in effect to the present. Throughout 1987 to 1992, fixed gear vessels had been allowed to fish inside the closed area, and in 1993 the area was closed to all fishing. Since 1987, the fishery has been regulated using by-catch restrictions and trip limits. In 1995, the fishery was severely restricted and limited to 10% (or 500 lbs) by-catches in the hake, cusk, and pollock fisheries, and to 10% or 200 lb. trip limits in the fixed gear fishery in 4Vn. This has been extended into 1996.

Between 1954 and 1984, most of the catch from this stock was taken from Division 4W by large otter trawlers in the spring. In 1984, Division 4W was closed to trawlers from May to December to prevent the capture of the abundant early 1980s year-classes. This caused a shift in the fishery to 4Vs. From 1984 to 1986, favourable catch rates in 4Vs resulted in an increase in landings from 4Vs to the point where they represented 40-60% of the reported total. In 1995, reported landings from 4Vs totalled only 57t. Since 1987, landings in 4W have increased five-fold to just over 5200t due largely to the expansion of the fixed gear fishery inside the closed area. In 1993, following the exclusion of all gears from the closed area, landings in 4W fell to just over 800t, and then to only 60t in 1994 and 1995. Landings in Division 4T and Subdivision 4Vn have been negligible since 1989.

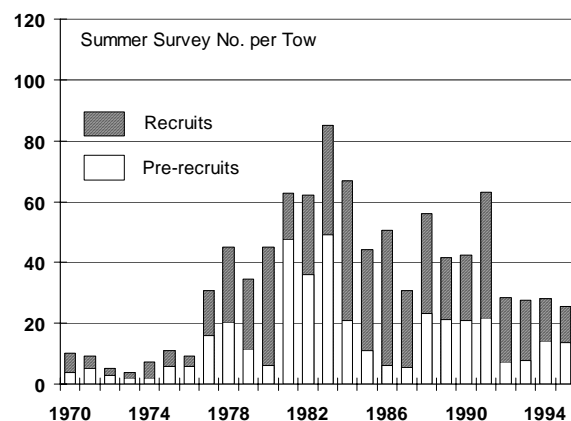
Resource Status

The evaluation of stock status was derived from reported landings, shore and at-sea based samples taken from commercial landings for size and age composition, and from the trends in abundance from two research vessel surveys (July and March). A **sentinel survey** was also conducted co-operatively by the Department of Fisheries and Oceans, the Department of

Human Resource Development, and the Fishermen and Scientists Research Society, which acted as the sponsor of the survey and whose members participated in the survey.

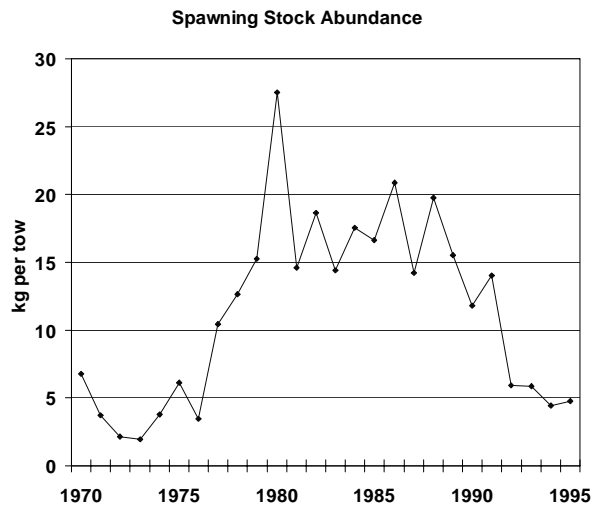
Questions regarding the validity of the **ageing** criteria used for eastern Scotian Shelf haddock have precluded the use of age-structured models for this resource since 1989 and have led to the development of length-based methods. These length-based methods are not, however, entirely independent of age determinations and therefore an age validation study was initiated in 1994. This age validation study has now advanced to the point where correction of historical age determinations will be possible. A program to accomplish this has been developed and is scheduled to allow for a resumption of age structured analyses in 1997.

Population abundance is presently low, relative to its long-term average; this is particularly true of large haddock. Estimates of the abundance of recruited (>36 cm) size classes from both the DFO March and July 1995 surveys are below long-term averages and have declined significantly since the early 1980s.

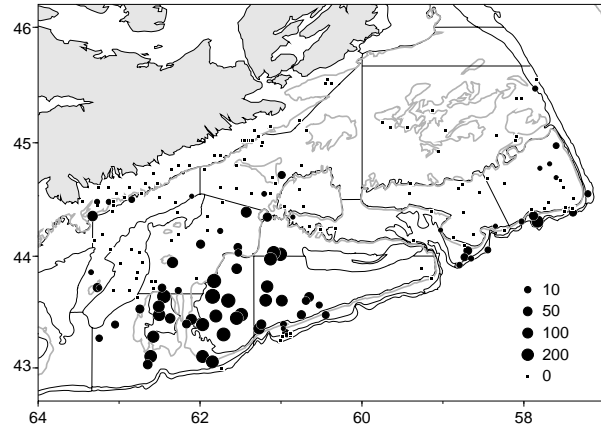


At present, **spawning stock biomass** estimated from surveys is on the order of 13,000t and is near the lowest observed since 1970. This

estimate assumes that all fish larger than 43 cm are mature.



The **4VsW sentinel survey** conducted in October of 1995 landed a total of just over 6t of haddock from a total of about 220 standardised longline sets (1500 hooks per set). Sets were distributed throughout divisions 4Vs and 4W from inshore waters to the 200 fathom contour. Although the results of this single survey do not allow for conclusions about resource status, the geographic distribution of catches were consistent with historical distribution patterns derived from DFO surveys. Since the sentinel survey also include sets inshore of the 50 m contour, the two surveys combined give a more comprehensive picture of the distribution and abundance of haddock. Unlike the results observed for cod, there was no indication of numerous haddock in inshore waters at this time of year. The sentinel survey does not give an index of pre-recruit abundance.

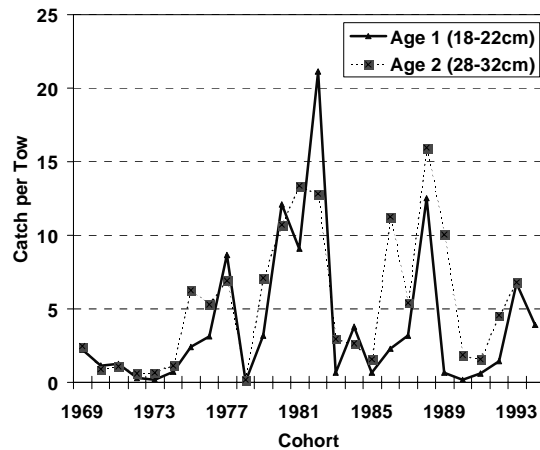


The largest year-class to **recruit** to the fishery since the early 1980s was that of 1988. The modal length of this cohort can be tracked through the population. The modal length of the survivors of this cohort was 40.5 cm in 1994 which was well below the estimated average length at age for 6-year old haddock and may indicate a reduced growth rate, extremely high exploitation or both. Results of the age validation study being conducted for 4TVW haddock, indicate that growth of these fish, beyond age three, is significantly slower than was assumed by the previous ageing criteria. In 1995, the modal length of the population remains at 40.5 cm with fish in size classes larger than 42.5 cm remaining well below the long-term (1970-1994) average abundance. These observations are consistent with the slower growth rate determined for this stock.

Since the **recruitment** pulse of the 1980s, the range of this stock has become more or less limited to Division 4W. This is related to the significant cooling trend observed on the shallow offshore banks (<100m) of Sub-division 4Vs during the late 1980s and early 1990s because haddock tend to avoid waters below about 3C⁰.

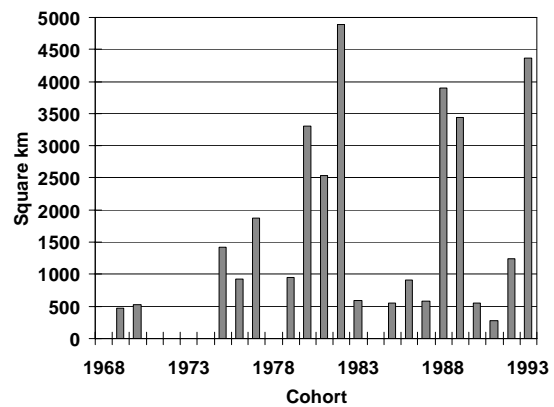
The 1995 summer survey indicates that the **1993 and 1994 year-classes** appear to be slightly above average (1970-1994). Although

these year-classes are of above average abundance in both Division 4W and Sub-division 4Vs, they are more abundant in 4Vs relative to the historical catches in that area.



Abundant year-classes are more widely distributed than weak ones. Spatial analysis of the 1993 and 1994 year-classes show that, at age one (18-24 cm), they occupy a total area which ranks well below the area occupied by the early 1980s year-classes. However, they are the most widely distributed year-classes to enter the population since the large 1988 year-class. Spatial analysis of the 1993 year-class at age 2 (28-32 cm) shows that it occupied a larger area than the 1988 year-class at the same lengths. The distributional pattern of the 1993 cohort is consistent with that of an abundant year-class.

Area Occupied by Age 2 (28-32 cm)
at Densities > 50 per tow



Catches of haddock in the **foreign small-mesh gear fisheries** give another indication of incoming recruitment. Comparison of both the 1994 and 1995 small mesh gear haddock catch rates at length to the long-term (1978-1993) catch rates in these fisheries indicate that the 1993 year-class was caught at slightly below average rates. It is somewhat difficult to compare the long-term catch rates to more recent catch rates since there has been both a gear change (introduction of the Nordmor grate in 1993) and the seaward relocation of the landward boundary of the small mesh gear box in 1994. Although it seems clear that these measures have had a significant impact on catch rates of haddock > 34 cm, their effect on catch rates of small haddock are as yet undefined. Catch rates of the 1993 year-class in 1994 and 1995 show it to be above average, and average respectively.

With the removal of all fishing activity from the closed area in 1993 and a closure of the fishery in 1994, **exploitation** has fallen to the lowest observed since 1970. Given that the directed fishery has remained closed in 1995, with removals of only 120t, exploitation has remained well below reference levels.

The range of fish sizes, average weight and length of fish and **condition factor** (a measure of plumpness) of this population have all declined. Fish size range has declined most significantly since the mid-1980s. Condition factor has declined by about 10-15% since 1970, gradually in Sub-division 4Vs, while in Division 4W it declined rapidly during the early 1980s and recovered somewhat before continuing its decline through the early 1990s. These observations are usually indicative of a population under stress.

In summary, although the trawlable mature biomass of this stock is currently low, there are continued indications of moderate to good recruitment. This is in contrast to the situation observed for 4VsW cod where both mature biomass and recruitment are currently low. With the continuing recruitment, prospects for rebuilding of the Eastern Shelf haddock are currently better than for the cod in this area.

Outlook

Spawning biomass, as indicated by the biomass of 43 cm and larger fish, is presently low. However, for the first time since 1988 there are signs that some average (1992) to above average (1993 and 1994) year-classes have been produced. These year-classes must be protected to promote stock rebuilding. The reduced exploitation which has been achieved over the past three years, if maintained in the near future, will aid this rebuilding process by allowing fish to realise greater growth and reproductive potentials.

For More Information

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