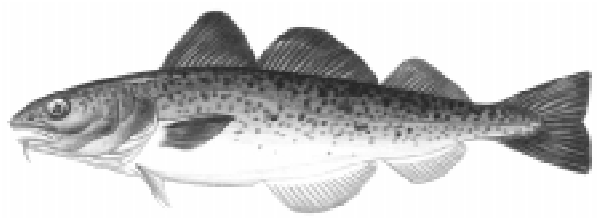
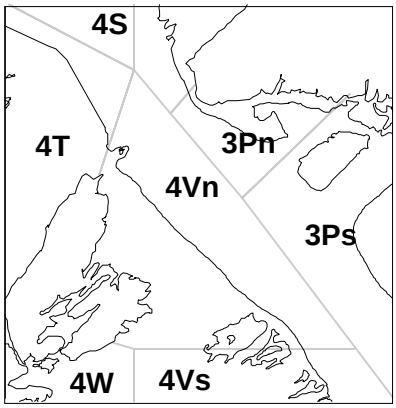




Cod in Sydney Bight

Background

The 4Vn region is known to represent a mixing ground between the resident 4Vn cod stock and larger neighbouring stocks, the 4TVn stock to the west and the 4VsW stock to the south. In addition, 4TVn cod overwinter along the shelf edge from Sydney Bight as far as Banquereau Bank region, leaving the Gulf in the late autumn and returning in the spring. During this period, the catch of cod in 4Vn would be comprised of both Gulf and resident cod, although 4TVn cod would make up the bulk, being a much larger stock. Thus, unknown quantities of 4Vn cod have been caught during the overwintering period. Mixing of Gulf of St. Lawrence (4TVn) cod with the resident stock and inability to apportion landings according to stock have complicated the assessment and management of the 4Vn stock.

Cod in 4Vn grow more slowly than the 4VsW stock to the south but more quickly than 4TVn cod. They are assumed to be fully mature at age 5, at a length of 48 cm. Tagging studies suggest that they overwinter in deeper water. 4Vn cod spawn in Sydney Bight in May.

Summary

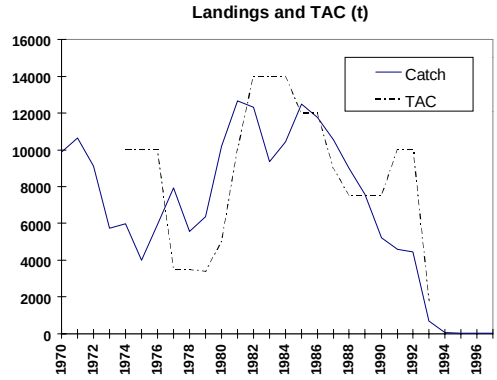
- The Sydney Bight cod stock rapidly declined in abundance and spawning biomass in the late 1980s and early 1990s.
- The assessment of this stock has high uncertainty.
- Spawning biomass reached a low in 1996 and has only increased slightly to 7,400 t in 1997.
- Recruitment was poor during 1988-92. There are signs of improved recruitment after the 1993 year-class.
- Post moratorium estimates of total mortality from the July survey indicate that natural mortality could greatly exceed the 0.2 level traditionally assumed. This high mortality implies slow stock rebuilding.
- Assuming current recruitment and mortality estimates, spawning stock biomass could increase in 1998 but will remain far below the long-term average.

The Fishery

Landings ('000t)

	70-79	80-89	90-93	1994	1995	1996	1997
TAC	6.7	10.5	7.3	*	*	*	*
Landings**	5.1	8.6	2.2	<0.1	<0.1	<0.1	<0.1
Landings***	7.1	10.6	3.7	<0.1	<0.1	<0.1	<0.1

* by-catch only
** May - October only
*** May - December only



Before extended jurisdiction in 1977, the cod fishery in 4Vn was traditionally a summer inshore longline fishery which exploited the banks south of the Laurentian Channel. During these years, large foreign trawlers fished along the Laurentian Channel edge in deeper water mainly during the winter months. These trawlers were targeting mainly Gulf of St. Lawrence (4TVn) cod which overwinter in the Sydney Bight area, whereas, the fixed gear fishery was prosecuted on the 4Vn resident stock. After the 200 mile limit was declared and foreign boats were denied access to this area, an inshore dragger fleet developed. Cod **landings** in NAFO Subdivision 4Vn have declined sharply during recent years. Throughout most of the 80's, catch quotas restrained the fishery, but after 1990 the catch was substantially less than the TAC. In September 1993, the cod fishery was closed and this moratorium is still in effect. In the few years prior to the closure, vessels using mobile gear generally managed to maintain a catch close to their allocation, whereas the longline fleet fared less well. Furthermore, the dragger fleet which had traditionally caught most of its catch between May and October began to transfer its activities toward the latter part of the year to exploit immigrant 4T cod. The effect was to maintain the overall catch for 4Vn even as the abundance of resident fish fell.

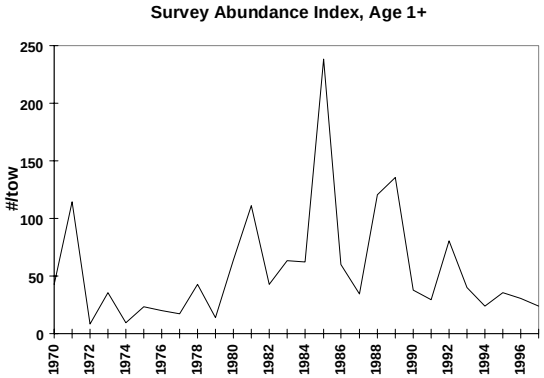
Information on the **overwintering migration** of Gulf of St. Lawrence cod into the Sydney Bight area was reviewed in the spring of 1994. From patterns of commercial fleet movements and results of tagging studies, it was clear that many 4TVn cod had departed the Gulf by mid November. Therefore it was decided to modify the 4Vn management unit by redefining the assessment period from May to December, to May to October, inclusive.

Less than 50 tonnes of cod landings have been reported since 1994, most of which were taken annually as bycatch in redfish and flounder fisheries.

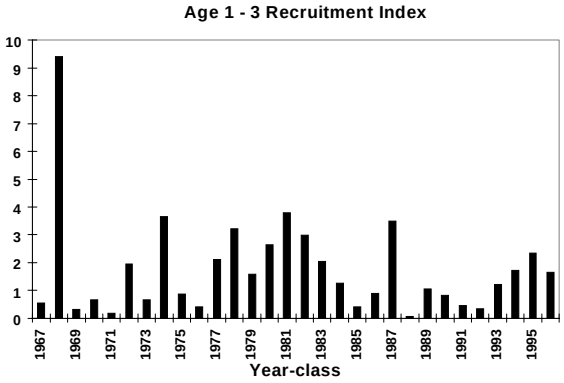
Resource Status

July Research Vessel (RV) Survey

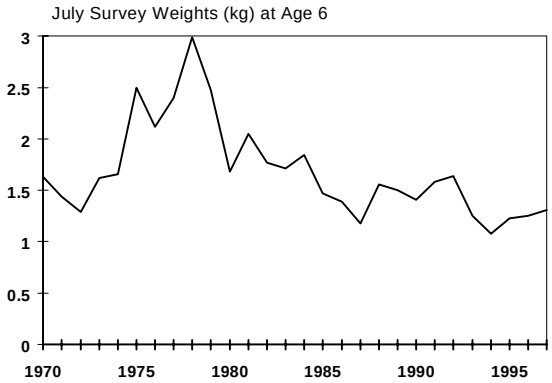
Interpretation of the **survey** data from 4Vn has always been difficult due to its high variability caused by small sample sizes and periodic incursions of other stocks into the area. Nevertheless, the July survey has been accepted as an index of abundance. The index has remained at a very low level, less than 40 (fish per tow), since 1993. In 1997, the 1992, 1993 and 1994 year-classes made up the bulk of the survey catch with 4 year-olds being slightly more abundant than adjacent year-classes.



After the good 1987 year-class, those for 1988-92 were low. Subsequently, particularly in 1995, there has been some signs of improved survey recruitment index.



The **size of** fish at age 6 was seen to peak in the late 1970s and has slowly fallen since then. Since 1994, the trend has reversed.

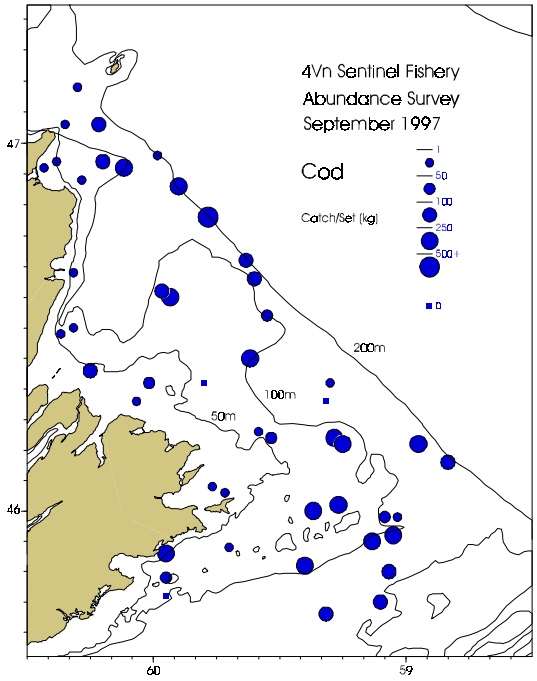


Sentinel Survey

Initiated in 1994, a **4Vn Sentinel Survey** conducted by commercial longliners follows a stratified random design similar to that used by the July groundfish survey. Seven surveys have now been completed; September 1994, and both July and September in 1995, 1996 and 1997. The geographic distribution of cod caught in all surveys was similar. The catch rate in September has declined from 1994 to 1997 (110, 106, 76 and 70 kg/1000 hooks, respectively). The September 1997 survey catch rate was comparable to that in July, and thus did not display the strong seasonal effect observed in 1995 and 1996. The reason for this is unclear as longline fishermen have previously found that July catch rates have historically been lower than in other months.

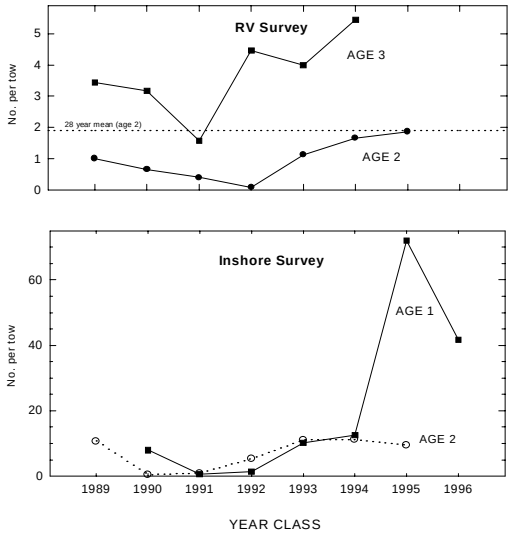
The sampling intensity of the sentinel survey is much greater than that of the DFO summer survey; however, the relative abundance or distribution of cod in July 1997 was comparable in locations where sampling coincided. Not unexpectedly, and as seen in previous years, proportionally more larger cod are taken by the sentinel survey; no doubt a function of gear selectivity. The research trawl is fitted with a small mesh liner so is capable of capturing very small cod, whereas, the size of hook used in the commercial longline fishery captures few small fish. Fishermen indicate that cod less than 35 cm (14 in) are rarely taken with number 12 hooks which are used for the survey.

The fishing industry has reported that high concentrations of dogfish can potentially interfere with the catch rate of cod. However, the Sentinel Survey occurs at a time of year of low dogfish abundance.



Inshore Survey

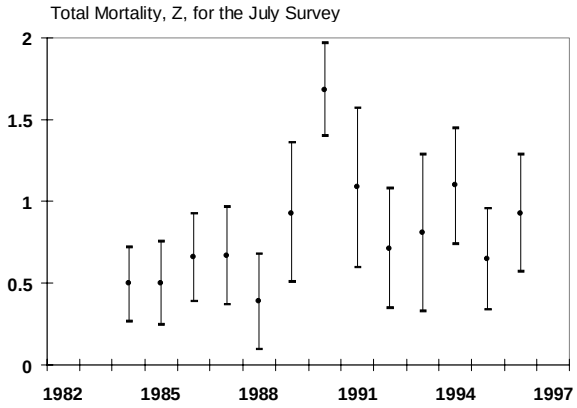
An **inshore survey** which captures smaller fish than the July RV, was initiated in 1991. The 1996 survey showed early signs of improved **recruitment** of the 1995 year-class. However, the age two estimate of this year-class in 1997 is not high. In this survey, the 1996 year-class also appears relatively strong. However, as with the 1995 year-class, further survey activity in 1998 is required to confirm the strength of these year-classes.



Population analysis

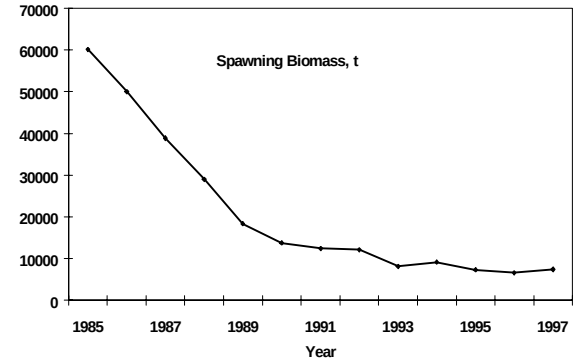
A **Sequential Population Analysis** was used to estimate the current status of the stock. As 4Vn is a known area of stock mixing, the degree to which the 4Vn area contains fish from other stocks will bias the results. To minimize this effect, the catch at age was reconstructed for the May to October period. Because of uncertainty about possible changes in survey catchability, the analysis was restricted to the 1985 - 97 period.

Total mortality rates, estimated from the July survey have remained high even after closure of the reported fishery activity in 1993. This suggests that mortality due to causes other than reported fishing activity has been higher than the level of 0.2 used in previous analyses.

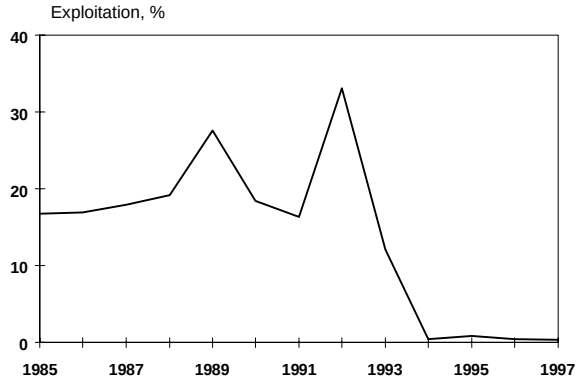


The sources of this mortality are not clear but could involve incidental mortality in other fisheries, mortality due to ocean climate changes and predation by seals and other species feeding in the area. For this reason, the population analysis was conducted assuming a natural mortality rate of 0.4 for 1985 which increased linearly to 0.8 in 1997.

The **population analysis** indicates that the population is severely depleted. The recent spawning (age 5+) biomass estimates are 6,600t and 7,400 t for the 1996 and 1997 values respectively. Recruitment estimates from the population analysis are dependent upon the assumptions concerning natural mortality. If natural mortality is a constant 0.4, the 1993-94 year-classes are about average. If the natural mortality steadily increases from 0.4 in 1985 to 0.8 in 1997, then the 1993-94 year-classes are the second and third highest on record. The biomass stability observed in the last few years is due to the growth of older fish which are surviving due to the fishery closure. A retrospective pattern is seen in the biomass estimates, which means that the most recent biomass figures tend to be over-estimated. Thus, the recent status of the stock is probably poorer than is shown in the following figure.



Exploitation rate, the percentage of the recruited population removed by the fishery, indicates that the fishery was removing increasing fractions of the stock from 1985 to 1992. These rates are lower than seen previously because of the higher natural mortality. The closure of the fishery in September, 1993, which is still in effect, resulted in the first significant decrease in exploitation levels. 1994 is the first year in the time series that exploitation was beneath the $F_{0.1}$ target.

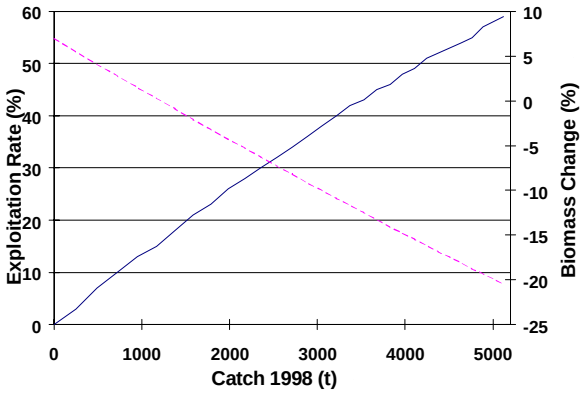


The main sources of **uncertainty** for this assessment are natural mortality, stock integrity and survey sampling intensity. The increase in modeled natural mortality is due to an unknown combination of changes in environmental conditions, seal predation, unreported catches and changes in life history. Sydney Bight is a known area of stock mixing and the integrity of the management unit is compromised by mixing

from the larger neighbouring 4VsW and 4T cod stocks. There is a lower sampling intensity in the July RV series than for other stock areas. The low sampling intensity means that the abundance information is more variable and hence the final estimates of stock status are less precise than those for most assessed stocks.

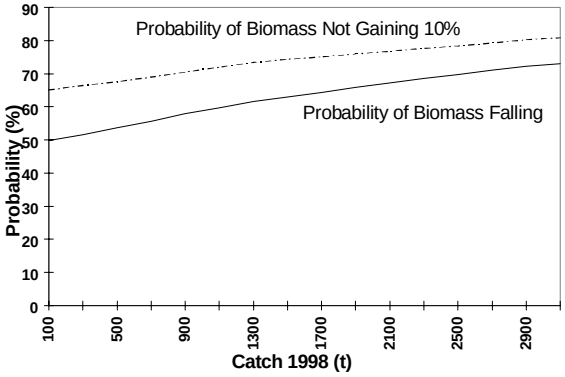
Outlook

The 1993 and 1994 year-classes are the first good year-classes to enter the fishable population since that of 1987. However, spawning biomass is very low and has not shown any recovery, although the 1997 biomass is slightly larger than the low seen in 1996. This increase is due to the growth of fish in the population and not due to recruitment.



Short term projections are done for a range of catch levels in 1998. For any catch in 1998, the associated exploitation rate is determined by reading up to the solid black line and across to the left. The percentage change in spawning stock biomass can be determined by reading up to the dotted line and then reading across to the right side.

These projections show that the biomass is expected to increase by about 7% if the fishery remains closed. Removals of approximately 1,000 t in 1998 would result in no increase in the spawning stock biomass.



The risk analysis shows a slightly less optimistic situation. When uncertainty in the estimation process is included, it suggests that even with no fishery in 1998 there is almost a 50% chance of the biomass falling and a 65% probability that the biomass will not increase by 10%.

Although the fishery has been closed since September, 1993, total mortality rates estimated from the research survey are high, indicating that there are other sources of mortality that are affecting stock rebuilding.

For more Information

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