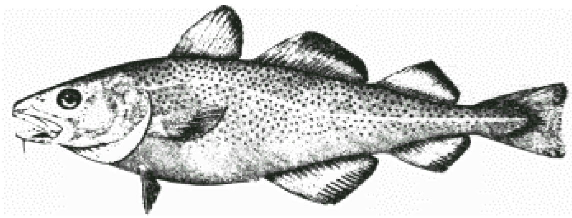


Northern (2J3KL) Cod

Background

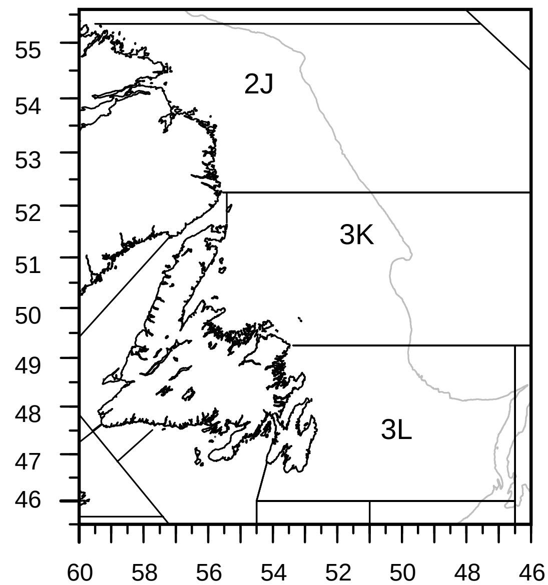
Cod has traditionally been called the "Newfoundland currency," and played a significant role in the settlement of the island. The northern (NAFO divisions 2J3KL) cod stock has been and remains potentially one of the largest in the world.

The stock covers about 117,000 square miles. Historically many cod migrated from overwintering areas offshore to feeding areas inshore. From the 1960s to the early 1990s the fishery was prosecuted with large otter trawlers offshore, mainly in the winter and spring, and a large fleet of smaller vessels that deployed traps, gillnets and hook and line inshore from late spring to autumn. Some fish overwintered inshore in the past. It appears that a substantial portion of the fish currently in the stock area remain inshore throughout the year.

Cod from this stock grow more slowly than in warmer areas. An age 5 cod would be about 50 cm (about 20 inches) long. Throughout the area female cod have a variable age at maturity, presently about age 5.

Cod in 2J3KL feed on a wide variety of food items. Capelin has historically been the major prey of adults.

This stock has supported a commercial fishery since the 16th century. For the century prior to 1960 the catches were mainly between 200,000 metric tons and 300,000 metric tons. With high catches in the late 1960s, mainly by foreign fleets, the stock declined until the mid-1970s. After the extension of jurisdiction in 1977, the stock increased until the mid 1980s but has since declined to a very low level. A moratorium on commercial fishing was in effect from July 1992 to July 1999.



Summary

- Status of the 2J+3KL cod stock at the end of 1999 was updated from 1998 based on an additional year of research bottom-trawl surveys, sentinel surveys, prerecruit surveys, acoustic surveys in specific areas, returns from tagging studies and catches from the re-opened fishery.

- It is clear that the size of the stock as a whole and the size of incoming year-classes remain low relative to levels in the 1980s.

- On the basis of the current distribution of fish and new information on genetics, it is concluded that information on stock status should be provided for the inshore and offshore separately.

- In the offshore, biomass remains extremely low. There are very few fish larger than 50 cm and older than age 5.

- In the inshore, sentinel surveys in 1995-1999, the index fishery in 1998 and the commercial fishery in 1999 have found very few fish in 2J and north of White Bay in 3K. From White Bay to the southern boundary of the stock, fish have existed in sufficient density to enable moderate to high catch rates in some times and places. These catch rates were attained under conditions of very low effort.

- Catch rates in the gillnet sentinel surveys, which constituted the bulk of the sentinel effort, increased from 1995 to 1998 and declined by half from 1998 to 1999. This is consistent with the relatively strong 1990 and 1992 year-classes passing through the fishery and being replaced by subsequent weaker year-classes. The decline in 1999 might also be attributable in part to decreased availability.

- An acoustic survey in Smith Sound (Trinity Bay) in winter 2000 provided a biomass estimate of about 22,000 t. A variety of other acoustic investigations at this and other times of the year found no other aggregations anywhere near this magnitude from western Trinity Bay to western Notre Dame Bay.

- The recovery of tags indicates high fishing mortality in 3K and lower fishing mortality in 3L.

- The biomass calculated from tag returns and catches was estimated to be at most 10,000 t in the inshore of 3K and 45,000 t in the inshore of northern 3L (Bonavista Bay and Trinity Bay). An estimate could not be produced for southern 3L because of the strong seasonal contribution of fish from 3Ps.

- Year-class strength appears to have declined from 1994 to 1996 but to be higher for more recent year-classes. It is likely that the spawning biomass of the stock will decline in the next few years even in the absence of a fishery.

- The risk associated with various TAC options cannot be evaluated. However, it would be sensible to maintain low levels of fishing mortality on all areas of the stock and to avoid concentration of effort on any component.

- Any fishing of those cod currently in the inshore might also create risk for recovery of cod in the offshore.

Species biology

Stock Structure

The abundance and **distribution** of cod in 2J3KL changed dramatically during the late 1980s and early 1990s. By 1994 there seemed to be very few cod anywhere in the stock area. Beginning in 1995 the perception of stock size and distribution changed when a large aggregation of cod was located in Smith Sound (Trinity Bay) and sentinel surveys started and achieved good catch rates in much of the area from White Bay in central 3K to the boundary with 3Ps.

In 1999, cod in the offshore remained broadly distributed at very low density during the autumn. In the inshore, acoustic studies in Bonavista Bay and Trinity Bay in autumn 1999 revealed small, scattered aggregations, with the largest quantity of fish in Smith Sound. In the winter of 2000 a large and dense aggregation of cod was again found in Smith Sound. An exploratory survey at that time in deep-water inlets from western Trinity Bay to western Notre Dame Bay found no other aggregations anywhere near the size of that in Smith Sound.

Shallow coastal waters appear to be important **nursery grounds** of juvenile cod from both the inshore of 3K and 3L and the offshore of 2J, 3K and 3L. The autumn research bottom-trawl surveys reveal that cod occur near the coast at ages 0 and 1 and move onto the shelf as they get older.

Tagging studies in 1999 support the earlier conclusion that the inshore of 3KL is inhabited by at least two groups of cod: (1) a northern resident coastal group that inhabits an area from western Trinity Bay northward to western Notre Dame Bay and (2) a migrant group from inshore and offshore areas of 3Ps that moves into southern 3L during late spring and summer and returns to 3Ps during the autumn. Only a small number of tagged cod from 3Ps were caught north of Trinity Bay. The tagging also provides evidence of considerable movement of cod among Trinity, Bonavista and Notre Dame bays. It is not known if there is currently movement between the inshore and the offshore in 2J3KL, because no aggregations sufficiently large to warrant tagging have been located in the offshore in recent years and there is no fishery offshore that might capture any tagged fish that moved there from the inshore.

Genetic studies indicate that populations on the Flemish Cap, on the southern Grand Bank and in Gilbert Bay in southern Labrador are substantially different from populations offshore in 2J3KL and inshore in 3KL. Recent samples from the offshore in 3KL have been aggregated into 3 geographic groupings, each of which is distinct from the others, suggesting that there are at least three offshore components. In the inshore, populations in all bays are different from one another, with the exception that Notre Dame Bay is not different from Bonavista Bay. Populations in inshore areas are more similar to one another than they are to populations in the offshore.

For the present assessment, it was decided to assess the offshore and the inshore separately, but not to assess individual bays within the inshore because of difficulties associated with seasonal movement of fish into 3L from 3Ps and the mixing of fish among bays.

Biological characteristics

The **proportion mature at age** increased among young female cod sampled during the autumn bottom-trawl surveys during the early 1990s and has fluctuated since (Fig. 1).

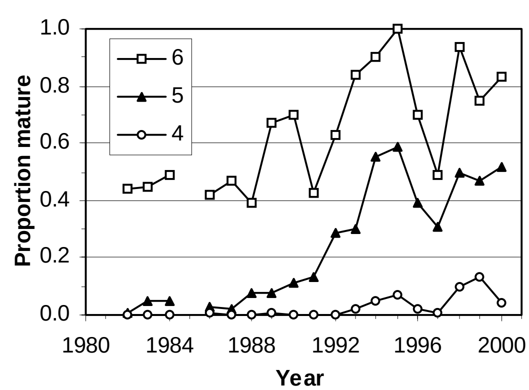


Figure 1. Observed proportion mature at age (females).

For example, the proportion of age 6 cod that are mature increased from about 40% in the 1980s to 75% or more in most recent years. Males generally mature about one year younger than females and show a similar trend over time.

Size-at-age of cod sampled during the autumn surveys declined during 1983-1985 and again in the early 1990s, especially in 2J (Fig. 2). Size-at-age has increased in recent years but is still below peak values observed in the late 1970s. Much of the variability in growth is related to variability in water temperature.

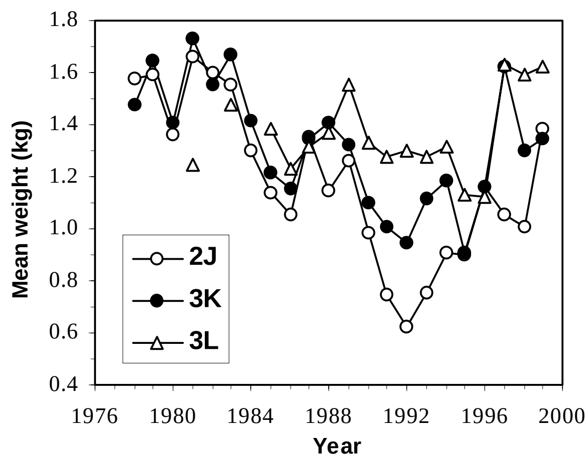


Figure 2. Mean weight (kg) at age 5 of cod sampled during autumn research surveys.

Condition of cod sampled during the autumn surveys, as measured by both gutted body weight and liver weight relative to fish length, declined in 2J in the early 1990s. Gutted condition has since returned to approximately normal levels whereas the liver index has improved but not fully recovered. In 3K, gutted condition declined in the early 1990s but has since improved whereas liver index has changed little. In 3L, gutted condition has remained relatively unchanged over time whereas liver index increased considerably in the early 1990s and has since returned closer to normal. The historic trends in condition indices are complex and poorly understood. Condition in 1999 was near normal. Fish harvesters in sentinel survey communities reported that the condition of cod caught inshore was good.

Biological interactions

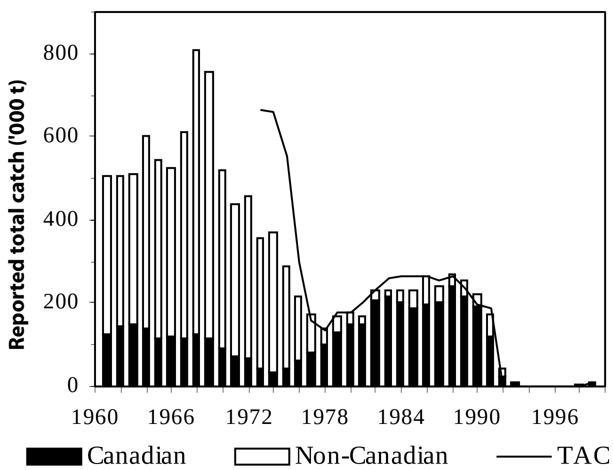
In recent winters, particularly those of 1997-1998 and 1998-1999, there were many reports of large cod being eaten by **harp seals** in coastal waters, particularly in eastern Notre Dame Bay and southwestern Bonavista Bay. There were few reported occurrences of such **predation** during 1999-2000 prior to the end of March.

The trend in biomass of **capelin**, the major **prey** of cod in this area, has been uncertain since the late 1980s (DFO 1999). Recent acoustic studies have detected some aggregations of capelin in the inshore but few offshore compared to the 1980s and early 1990s. It is possible that the tendency for cod to move from the inshore to the offshore and from south to north may be greater if capelin biomass increases both offshore and to the north.

The Fishery

Catches by non-Canadian fleets increased rapidly in the late 1950s and 1960s, with the total catch peaking at 800,000 metric tons in 1968 (Fig. 3). Catches both offshore and inshore declined during the 1970s. The stock declined to a low biomass by 1977.

Following extension of jurisdiction the stock began to recover as a consequence of smaller catches, entry of the strong 1973-1975 year-classes, and an increase in individual growth rate. However, recovery of the spawner biomass stopped after about 1982 as a result of higher fishing mortality, entry of the weak 1976-1977 year-classes and a decline in individual growth rate. The 1978-1982 year-classes were moderate to strong but experienced slow growth rates. Catches during the middle to late 1980s were relatively stable but fishing mortality was high and increasing. The 1986-1987 year-classes appeared strong at an early age but, in concert with older year-classes, appeared to decline very rapidly in the early 1990s. Fishing mortality was very high during this period but reported landings including documented discards are insufficient to account for the decline observed in the research vessel indices. A moratorium on directed commercial fishing was imposed in July 1992.



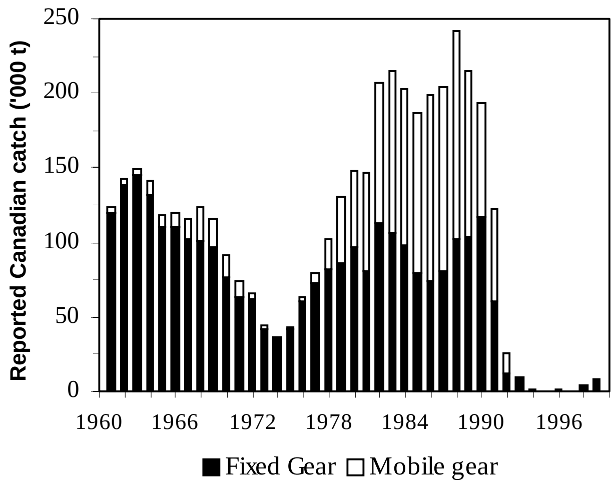


Figure 3. Reported catch for all countries (above) and Canada alone (below).

Reported catches in 1993-1998 came from bycatch and sentinel surveys (1995-1998) and estimates of catches during food fisheries (1994, 1996, 1998). The reported catch of about 4,500 t in 1998 came mainly (68%) from an inshore index fishery.

Landings (thousand metric tons)

Year	62-76 Avg.	77-91 Avg.	1995[1]	1996[1]	1997[1]	1998[1]	1999[1]
TAC	N/A	N/A	0	0	0	0	9
Can. Fixed	88	90	+	2	1	5[2]	8
Can. Mobile	9	84	0	+	+	+	0
Others	405	38	0	0	0	0	+
Totals	502	212	+	2	1	5[2]	8

[1] Provisional.

[2] Catch from bycatch, a food fishery, the sentinel surveys and an index fishery.

[+] Catch less than 500 metric t.

In 1999 the commercial fishery was re-opened with a TAC of 9,000 t in the inshore for vessels under 65 feet. The allocation was 8,600 t for the commercial fishery, 300 t for the sentinel survey and 100 t for bycatch. Reported landings were approximately 8,000 t from the commercial fishery and 200 t from the sentinel survey, which together with the estimate of 235 t for the food/recreational fishery totalled approximately 8,500 t. There is no evidence of substantial unreported deaths, either from discarding by the shrimp and the cod fisheries or from high-grading in the cod gillnet fishery.

The commercial fishery was conducted on the basis of individual quotas, with participants licenced to fish only in the Division of their home port, so landings by Division reflected both the availability of fish and the number of licences in each Division. Landings increased from 2J (< 1% by weight) to 3K (43%) to 3L (57%).

Participants in the commercial fishery were permitted to fish a limited quantity of either gillnets or linetrawls. Handlines could be fished in conjunction with either gear, but traps were not permitted. When all sources of landings (commercial, food and sentinel) were combined, gillnets contributed 87% by weight, linetrawls 2% and handlines 11%.

The total **catch at age** in 1999 comprised a range of ages, with ages 4 to 9 most prominent by number and age 7 (the 1992 year-class) dominant. The total catch at age strongly reflects the selectivity of the gillnets, which tend to select ages 6 and 7. The hook and line gears caught mainly ages 4 and 5 in 1999. Only 2% (by number) of the total catch was older than age 9.

Industry perspective

A perspective on several aspects of the 1999 sentinel survey and commercial fishery is available from the responses to a questionnaire sent by the Fish, Food and Allied Workers (FFAW) to the fish harvester committees representing the 53 sites where a sentinel survey was conducted by the FFAW in 1999. Ninety percent of the committees said that the sentinel survey catch rates reflected cod abundance as perceived by fish harvesters.

In response to whether commercial catch rates in 1999 were low, average or high, 41% said low, 37% said average and 22% said high. All responses from southern Labrador to White Bay were “low”. “Low” responses also came from some areas on the Baie Verte Peninsula, two areas in eastern Notre Dame Bay, and several areas in the region from inner Trinity Bay to the northern Avalon Peninsula. “High” responses came from sites in the region from the most eastern part of 3K to the Smith Sound area of western Trinity Bay and also from several areas on the southern Avalon Peninsula. In response to whether commercial catch rates were lower, the same or higher than during the 1998 index fishery, 24% said lower, 45% said they were the same, and 31% said higher. Half of the “lower” responses came from southern 3K. Most of the “higher” responses came from either 2J or northern 3K, where catch rates were “low”, or the region from easternmost 3K to Smith Sound in Trinity Bay, where catch rates were “high”. In response to whether “signs” of small (up to 18 inches) fish were worse, the same or better than in 1998, 16% said worse, 34% said the same and 50% said better. In response to whether the overall condition of cod caught during 1999 was poor, average or good, 10% said average and 90% said good.

Resource Status

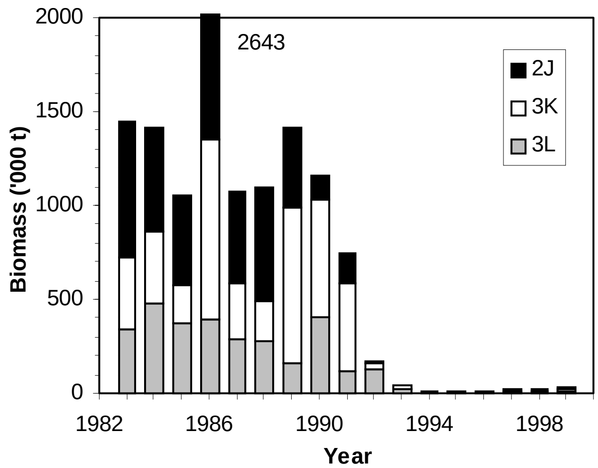
Stock status at the end of 1999 was updated from 1998 based on an additional year of research bottom trawl surveys, sentinel surveys, prerecruit surveys, acoustic surveys in specific areas, returns from tagging studies and catches from the re-opened fishery.

On the basis of the genetic information described above, it was concluded that information should be provided for the offshore and inshore separately.

Offshore

The abundance index from the **autumn research bottom-trawl survey** in 2J3KL declined from 1995 to 1997, increased a little in 1998 and doubled from 1998 to 1999. The recent increase occurred in 3K and 3L but not in 2J. The increase occurred at most ages and was most pronounced at ages 2 and 3. As in the previous 5-6 years, very few fish larger than 50 cm and older than age 5 were caught in 1999.

The biomass index from the autumn survey increased a little from 1995 to 1997, remained unchanged in 1998 and increased 70% from 1998 to 1999 (Fig. 4). The biomass index in 1999 was 2.4% of the average in the period 1983-1988 (excluding 1986).



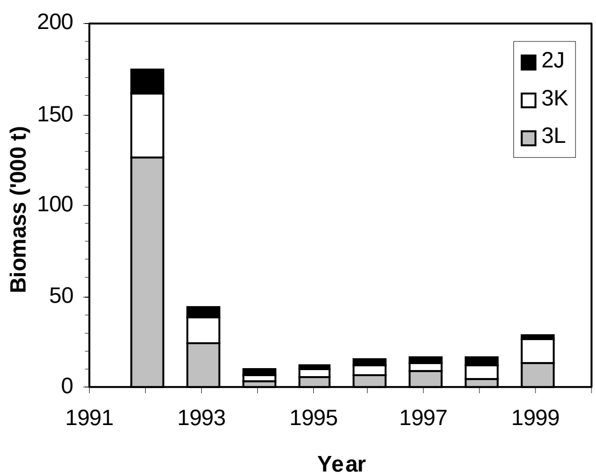


Figure 4. Biomass index from autumn bottom-trawl surveys in 1983-1999 (top). The data from 1992-1999 are displayed more clearly in the bottom panel.

The abundance and biomass indices from the **spring research bottom-trawl survey** in 3L increased from 1998 to 1999 (Fig. 5). Nevertheless, the biomass index for 1999 was only 2.7% of the average in the period 1986-1989.

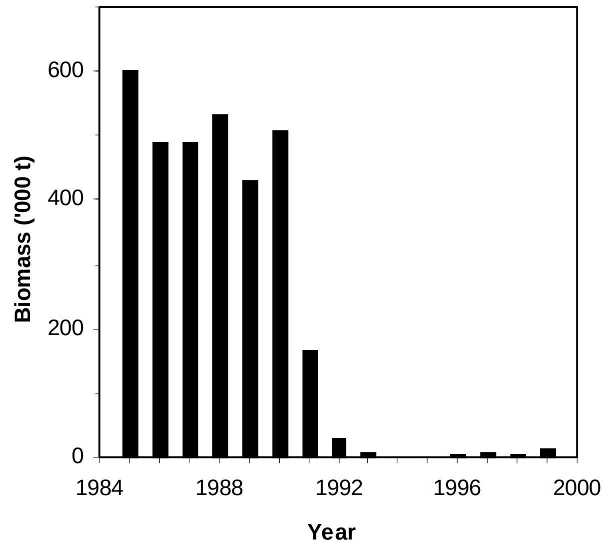


Figure 5. Biomass index from spring bottom-trawl survey in 3L.

Offshore acoustic studies were conducted in Hawke Channel in 2J in June 1994-1996 and 1998-1999. The biomass decreased by half from 1994 to 1995 and continued to decline in succeeding years. The 1999 estimate, which was approximately 16% of the 1994 estimate, may be low because survey coverage was incomplete.

Inshore

The **sentinel surveys** in 2J3KL, initiated in 1995 to provide catch rates of cod in inshore waters, have been conducted primarily with gillnets. Linetrawls have been used extensively in only a few areas. Handlines and cod traps have been used much less. In 2J and in 3K north of White Bay, catch rates have been low since the start of the surveys. From White Bay to the southern boundary of the stock, fish have existed in sufficient density to enable moderate to high catch rates in some times and places. These catch rates were achieved under conditions of very low total fishing effort and catch.

The sentinel survey data were standardized to remove site and seasonal effects and produce annual indices of total catch rate and catch rate at age for 3K and 3L combined. Gillnets and linetrawls were treated separately (Fig. 6). Gillnet catch rates increased from 1995 to 1998 but declined from 1998 to 1999. Linetrawl catch rates showed relatively little change from 1995 to 1996, increased in 1997, and declined again in 1998 and 1999.

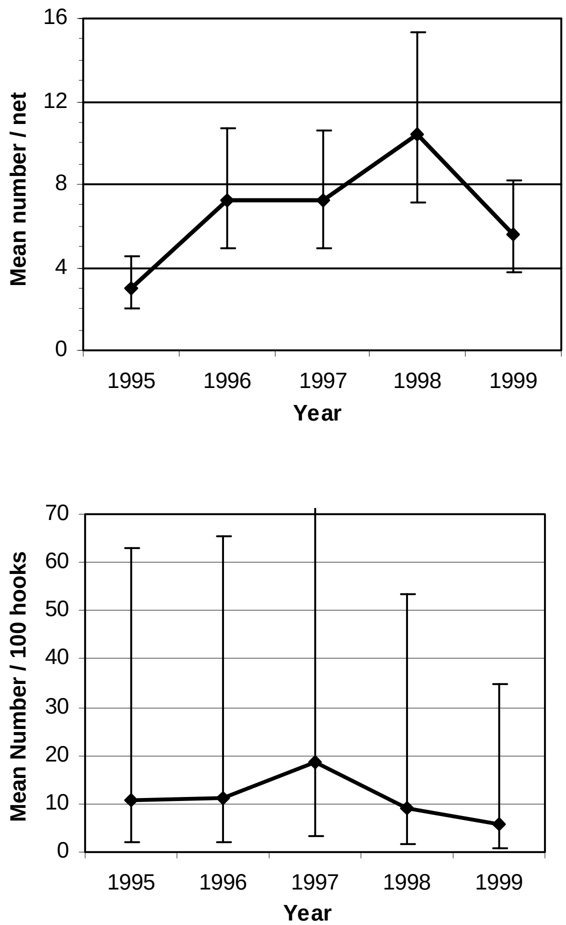


Figure 6. Standardized catch rates from sentinel surveys in 3KL; gillnets above and linetrawls below.

The catch rates at age indicated that the 1990 and 1992 year-classes were relatively strong and that all subsequent year-classes are weaker. The pattern in age-aggregated gillnet catch rates is consistent with the 1990 and 1992 year-classes entering and then passing through the fishery and being replaced by the weaker year-classes. It is also possible that the decline from 1998 to 1999 was attributable in part to decreased availability of fish to the gear, such as a distribution over a greater range of depths.

Catch rates were calculated from catch and effort data recorded in logbooks maintained by participants in both the **index fishery** in 1998 and the **commercial fishery** in 1999. The spatial pattern was similar in the two years, with catch rates very low north of White Bay, increasing from White Bay to eastern Notre Dame Bay, generally highest from northern Bonavista Bay to western Trinity Bay, lower from eastern Trinity Bay to the eastern Avalon Peninsula and increasing again on the southern Avalon Peninsula (Fig. 7). No inferences about annual trends should be drawn from these two years of data, especially since the dates of fishing varied between the two years.

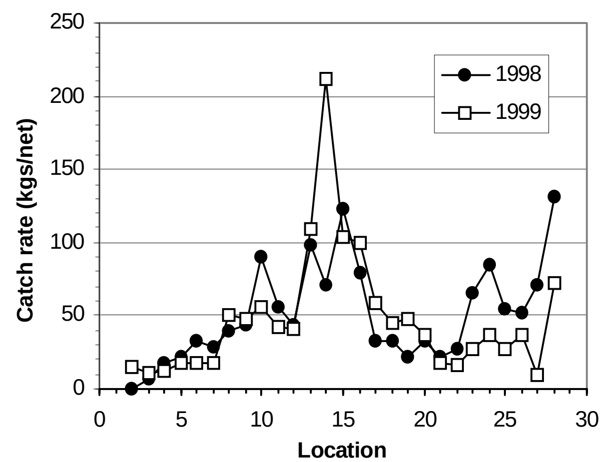


Figure 7. Gillnet catch rates by statistical section during the 1998 index fishery and the 1999 commercial fishery. From north to south, Section 2 starts at Cape Bauld, 6 at Cape St. John, 10 at Cape Freels, 14 at Cape Bonavista, 20 at Grates Point, 24 at Cape St. Francis and 27 at Cape Race.

The **catch at age** in the 1999 fishery was dominated by the 1992 year-class, but there were important contributions by the 1993 and 1994 year-classes. Only 2% (by number) of the total catch was older than the 1990 year-class.

For the analysis of **tag return data**, the inshore was divided into three geographic areas: 3K, northern 3L (Bonavista and Trinity bays) and southern 3L. The returns from tags applied during 1999 were highest for fish tagged in 3K (26%), lowest for fish tagged in northern 3L (7%) and intermediate in southern 3L (11%). Many of the recoveries of the tags applied in southern 3L occurred in 3Ps. It is presumed that these fish had migrated into 3L from 3Ps during the spring.

Information from recaptures of cod tagged in 3KL during 1997, 1998 and 1999 were used to estimate **exploitation rates** for each of the two periods of the 1999 fishery: the July opening and the first 5 weeks of the September-November opening. Exploitation rates for the first and second openings were estimated to have been at least 19% and 13% in 3K and 2.3% and 3.8% in northern 3L. The exploitation rates could possibly be higher because of an unknown effect of migration of tagged fish out of the areas. Reliable estimates could not be produced for southern 3L because of the strong seasonal contribution of fish from 3Ps.

When combined with the catches recorded for each area and time period, these exploitation rates suggest **biomasses** of at most 8,900 t in 3K and 49,000 t in northern 3L during July, and 11,000 t in 3K and 42,000 t in northern 3L during September-October.

Inshore acoustic studies have been conducted in Smith Sound in western Trinity Bay at various times since spring 1995. The quantity of cod detected in the Sound at any specific time will depend not only on their abundance but also on where the cod are in their annual cycle of movements. Fish overwinter in deep water in the Sound and perhaps spawn there in the spring before moving into shallow water and along the coast from late spring to early autumn. They then return to the Sound in late autumn or early winter. Two acoustic surveys in January 2000 provided an average biomass estimate of about 22,000 t. Sampling by bottom-trawling showed the 1990 and 1992 year-classes to be present in relatively large numbers and the 1995, 1996 and 1997 year-classes to be well represented. Previous biomass estimates for Smith Sound have been as low as 150 t in April 1996 and as high as 21,000 t in April 1997.

An exploratory acoustic study of similar deep-water inlets from western Trinity Bay to western Notre Dame Bay in January 2000 found no other aggregations anywhere near the size of that found in Smith Sound at that time.

Acoustic surveys directed at herring in autumn 1996 and 1999 both yielded cod biomass estimates of 5,000 t for Bonavista and Trinity bays combined.

An acoustic study in southern Bonavista Bay in November-December 1999 did not encounter any large concentrations of cod.

A new **recruitment index** was derived from catch rates of juvenile (ages 0-3) cod during the following studies: experimental squid traps; experimental fixed-station bottom-trawling (FS BT) with a Campelen trawl, both inshore and offshore; beach seine; pelagic 0-group monitoring with an IYGPT trawl, both inshore and offshore; sentinel survey linetrawl (LT); sentinel survey 5.5 inch gillnet (GN); sentinel survey 3.25 inch gillnet (GN); stratified-random bottom-trawl (SR BT) monitoring with a Campelen trawl, both inshore and offshore. The years during which each series was operational and the ages of cod caught and considered during this analysis are:

Data source	Cod ages	Years
Squid trap	0-3	1991-1994
FS BT inshore	0-3	1992-1995
FS BT offshore	0-3	1992-1995
Beach seine	0-2	1992-1997
IYGPT inshore	0	1994-1999
IYGPT offshore	0	1994-1999
Sentinel LT	3	1995-1999
Sentinel GN 5.5	3	1995-1999
Sentinel GN 3.25	2-3	1996-1999
SR BT inshore	1-3	1996-1998
SR BT offshore	0-3	1995-1999

The recruitment data from inshore and offshore were treated together because the inshore appears to be an important nursery area for cod populations spawning in both the inshore and the offshore. These data were combined to produce a single index of relative year-class strength (Fig. 8).

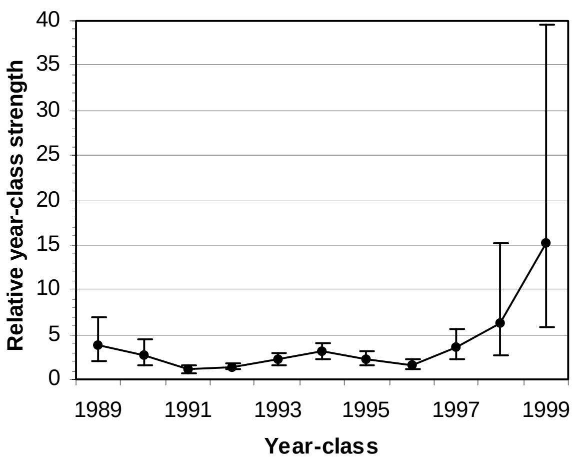


Figure 8. Standardized year-class strength.

The index declines from 1989 to 1991, increases to 1994, declines to 1996, and then increases to 1999. The ultimate strength of the 1998 and 1999 year-classes is yet to be determined. Their present strength is known only imprecisely. Moreover, the ability of the index to predict recruitment to the fishable population remains uncertain, particularly because it does not pick up the 1992 year-class that was relatively strong in sentinel and commercial catches.

Sources of uncertainty

It is unknown whether the inshore spawner biomass could increase under low fishing mortality or whether the present biomass is near the maximum that can be supported.

It is unknown whether recovery of the offshore is more likely through resurgence of the remnant that still remains in the offshore or from inshore fish moving offshore. If the inshore is not near carrying capacity then allowing biomass to increase makes it more likely that inshore fish may move offshore.

Uncertainty about migration makes the magnitude of the bias in tagging estimates of exploitation rates uncertain. Fish caught in southern 3L comprise a significant proportion of fish migrating seasonally out of 3Ps rather than resident 3L fish. More tagging data will allow a better estimate of fish movement between 3Ps and 3L and within the 3K/3L area and improve estimates of exploitation rate and biomass.

The 1998 and 1999 year-classes, although still relatively poor compared with historical levels, appear to be stronger than other year-classes since the moratorium. However, these year-classes are estimated with considerable uncertainty. The relationship between 0-group abundance and subsequent recruitment to the fishery is uncertain. For example, the 1994 year-class also appeared to be strong as 0-group fish but was not significantly higher than surrounding year-classes in subsequent surveys or the fishery.

There is uncertainty in the amount of fish that die as a consequence of fishing activity but do not appear in the catch statistics used in this assessment. There are no direct estimates of unreported catches and high-grading. There are no accurate estimates of removals in food fisheries.

The effect of the large harp seal population on the recovery of the northern cod stock remains uncertain. Estimates of harp seal population size available for this assessment were projections from the last pup count carried out several years ago. The current size of the population will be estimated this year and will include data from the 1999 pup census, allowing a reappraisal of the possible role of harp seals in the lack of recovery of the northern cod stock.

There are concerns that the capelin stock may not be sufficiently large in the offshore to support a recovery of offshore cod. Other prey items exist in the offshore, but capelin is historically the most important prey in the diet of 2J3KL cod and capelin abundance has been shown to influence cod growth, condition and reproductive output in Barents Sea and Iceland stocks.

Outlook

It is clear that the size of the northern cod stock as a whole remains low relative to levels in the 1980s. There is no recovery of spawner biomass in the offshore and there is no evidence that the inshore spawner biomass increased from 1998 to 1999.

Rebuilding in the offshore can come about through resurgence from remnants that continue to exist on the shelf and offshore banks, or through a movement of fish to the offshore of 2J3KL from elsewhere such as the inshore. An increase in the inshore component may be possible through good recruitment, growth and low levels of fishing mortality, however the capacity for the inshore to sustain a larger biomass of fish than that which currently exists is unknown.

Year-class strength appears to have declined from 1994 to 1996 and to have increased since, although there is considerable uncertainty associated with estimates for recent year classes. It is therefore likely that the spawning biomass in both the inshore and offshore will decline in the next few years even in the absence of a fishery. If the apparently higher 1998 and 1999 year-classes survive then spawner biomass may begin to increase when they mature.

It is certain that the inshore fishery will not return to its former prominence until such time as a substantial biomass of cod builds up in the offshore and these fish resume a summer feeding migration to the inshore. Management options for the inshore should therefore be evaluated in terms of the risk both of detrimental effects on the inshore component and of hindering the recovery of the offshore component.

Management options for 2000 might include a TAC increase, a status quo TAC, a limited index fishery for scientific purposes or a moratorium on all cod-directed fishing. With a precautionary approach in mind, the risks that were evaluated included: causing a decline in the spawner biomass of the inshore component, hindering recovery of the spawner biomass in the offshore, exceeding acceptable exploitation rates, and eliminating small sub-components.

There is some risk that spawner biomass in the inshore will decrease even with no fishing because year-classes subsequent to the 1992 year-class appear weak. The 1994 year-class, which was relatively strong in the 0-group surveys, has not been prominent in either sentinel or commercial catches.

The risk to the recovery of the offshore with respect to any fishery in the inshore cannot be determined and will depend in part on whether recovery in the offshore is through resurgence of offshore fish or through inshore fish moving offshore. The latter is more likely to occur if the spawner biomass in the inshore is allowed to increase. Any inshore fishery, although based primarily on the inshore component, may also remove any offshore fish that might continue the historic summer feeding migration to the inshore.

The 9,000 t TAC led to exploitation rates well above a 20% reference level in 3K in 1999 and this is unacceptable under a precautionary approach. If the inshore cod presently inhabit only a limited fraction of their potential range then under a precautionary approach exploitation rates should be low enough to allow it to expand.

Lower exploitation rates occurred in northern 3L in 1999, consistent with other information on the distribution and abundance of fish.

Reliable estimates of exploitation rate could not be produced for southern 3L in 1999 because of the strong seasonal contribution of fish from 3Ps. If this migration is less in any year, then even a small fishery could pose unacceptable risks to resident inshore southern 3L fish and to any portion of the offshore remnant that might continue to migrate inshore in the summer.

Even an index fishery may be associated with an increased risk of the inshore spawner biomass declining and the offshore not recovering. However, if carried out in close collaboration with science, it is capable of yielding vital information on the present distribution, abundance and age composition of the inshore component of the northern cod stock.

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